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JAPAN'S MANUFACTURE AND IMPORTATION OF IRON GOODS.

By M. Kawara.

Industrial interests and economic ambitions dictate modern statecraft, and it is in these factors that we shall find the solution to the increasingly interesting problem of Japan's aims and policies, internal and international. Mr. Kawara's view, typical of well and widely informed Japanese opinion, is reassuring as to the future stability of his country's relations with the Western World; for it implies so intimate and essential an interdependence between Japanese manufacturing and European or American mining and producing enterprises, that the closely cemented relationships of trade and commerce should make war impossible.—THE EDITORS.

IT is not necessary to dwell at length upon the importance of the Far Eastern market for American manufacturers. Information regarding this market, however, seems to be scanty. It is for this reason that I have undertaken to give some idea about the situation of the iron industry in Japan, one of the most important markets in the East. A brief historical sketch of Japan's home manufacture and foreign importation will be given first, then the present situation, and lastly the outlook for American manufacturers.

The Japanese were acquainted with iron from very early times. A sword that was used by one of the ancestors of the present Emperor about 800 B. C. is still in existence. Later, when the great civil war broke out in the sixth century, sword smiths and armour smiths came to occupy a prominent place. Many interesting stories are connected with sword smiths, although this is no place to go into these. From this time on down to about three-hundred years ago, no noticeable progress had been made. At the beginning of the seven-

teenth century, when the Tokugawa dynasty came into possession of the political power and peace was restored, all branches of industry began to prosper. The demand for iron implements increased, and the scarcity of iron supply began to be felt.

Up to this time the supply of iron was furnished by the native smelters, who reduced the magnetic ore, in the form of ferruginous sand, in crude charcoal furnaces. The product was expensive. The Dutch traders found it very profitable to import iron bars. They thus brought a considerable amount yearly.

This state of affairs continued until fifty years ago. The revolution of 1868 changed conditions entirely. The country was thrown open to foreign commerce, and for the first time Western machines and instruments were introduced to the natives. It did not take long to convince the people of the advantages of the new appliances. It was at this time that the government established a blast-furnace plant at Kamaishi, some five-hundred miles north-east of Tokio. The furnaces were built after the Dutch fashion, and charcoal was used for fuel. The quality of the product was found very unsatisfactory, so the plant was soon sold to a private corporation, which subsequently failed. This seems to have given a setback to the iron industry. For the next thirty years practically nothing was done in iron-smelting work. At the time of the Japanese-Chinese war, the government sorely felt the need of a smelting plant, so it started one at Fukuoka, on Kiushiu Island, where coal is abundant, the ore for this plant being imported from China. All necessary machines and furnaces were bought from Germany, and the actual smelting work was begun about five years ago. Bars, plates and rails are now being turned out. The quality still seems to be unsatisfactory. It is doubtful whether the plant will ever be on a paying basis so long as it remains in government hands.

Very recently, a syndicate was formed by some British and Japanese capitalists for the purpose of establishing a large smelting plant in Hokkaido, or Yezo as it is more commonly called in America. How far the work has been carried on I have not been able to find out.

In the mean time the demand for iron goods rose higher and higher. Railroad companies and steamship companies were formed one after another; factories, such as spinning, weaving, paper mills, etc., sprang up here and there in rapid succession. At this stage all machines were bought either from America or Europe; but it was absolutely necessary to have them repaired at home. Small iron works mainly for this purpose were started in the principal cities.

Then, gradually, enterprising manufacturers began to build machines of small sizes.

From this time on the growth of the iron industry has been steady. To-day there are over one-thousand iron works. The figures given in the census of 1904 are as follows:

TABLE I. JAPANESE FACTORIES AND EMPLOYEES.

Kind of Factory.	No. of Factories.	No. of Employees.
Machine-making factories	761	57,509
Ship-building yards	46	21,026
Tool-making works	228	10,754
Foundries	85	2,478
Total	1,120	91,767
Average number of employees in each shop		82

It is to be noted here that shops are very small compared to the similar shops in the Western countries, as may be seen from the number of employees. Since the census was taken, there must have been an increase both in the number of factories and employees, especially in the latter. However this increase will not exceed, roughly speaking, 20 per cent. In general, machines built in Japan are small in size and rather poor in workmanship. Larger and finer machines are imported from abroad. This does not mean that the Japanese are incapable of producing such machines. The trouble lies in the fact that capital is scarce. Given first-class facilities, they can do as well as most people can.

Now let us turn toward the importing business and see how it developed. As has been incidentally touched upon, the importation of iron goods was going on even under the Tokugawa *régime*. After the revolution of 1868, there came a sudden increase in this trade. Still, up to the time of the Japanese-Chinese war of 1894-95, the amount was insignificant. While the war was going on, the iron trade in general reached the highest mark of prosperity experienced up to that time, chiefly for the reason that the government ordered a large amount of war materials. At the conclusion of the war, the indemnity China paid Japan caused the abnormal expansion of all industries, and the importers, as well as the home manufacturers, were very busy for the following two years. Table II and the curve show these facts. A depression came after the abnormal expansion, as the natural consequence; 1899 is the year in which the reaction was felt most severely. Here the imported goods dropped down to 15,000,000 yen. or about $7,500,000, from 25,000,000 in the preceding year. Still, this is about five times as much as before the war. The revival came in 1900, and in the following three years a gradual rise took place.

TABLE II.

THE AMOUNT OF IRON GOODS IMPORTATION FROM 1892 TO 1907 IN YEN (TWO YEN EQUIVALENT TO ONE DOLLAR.)

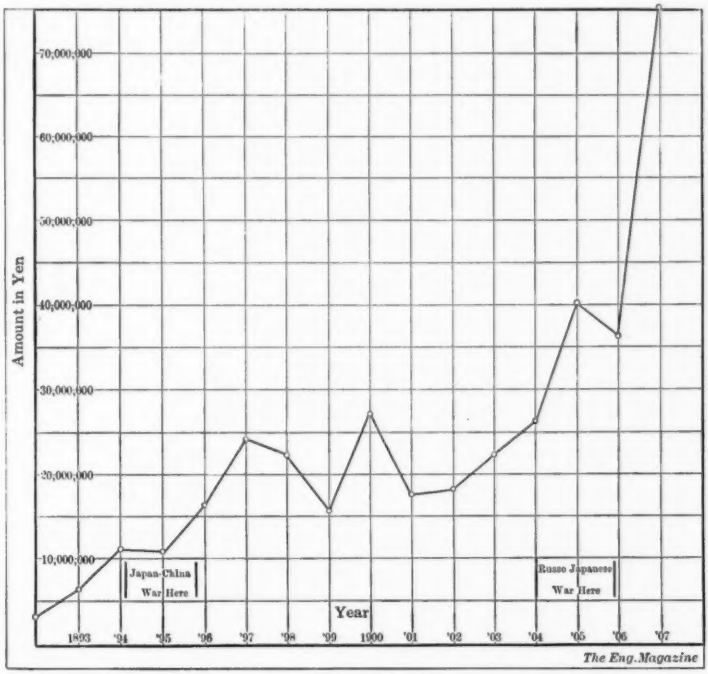
(From the Report of Department of Finance.)

Kind of Article.	1892	1893	1894	1895	1896	1897	1898	1899
Electric machinery	———	———	———	———	14,000	168,000	91,000	13,000
Locomotives and cars	200,000	357,000	1,580,000	1,164,000	1,621,000	4,236,000	4,283,000	1,968,000
Spinning machines and parts	355,000	1,913,000	2,858,000	1,896,000	2,992,000	5,401,000	3,089,000	773,000
Steam engines, boilers and machines.	180,000	158,000	215,000	432,000	891,000	1,501,000	921,000	688,000
Iron nails	906,000	888,000	1,333,000	1,278,000	1,440,000	1,458,000	1,150,000	2,223,000
Iron rails	67,000	667,000	1,209,000	926,000	2,595,000	3,325,000	2,632,000	435,000
Bars and rods	872,000	976,000	1,339,000	2,086,000	2,360,000	3,046,000	4,062,000	2,604,000
Pigs, ingots and steel	476,000	740,000	1,106,000	1,177,000	1,544,000	1,413,000	2,347,000	1,920,000
Iron plates and sheets	411,000	579,000	1,338,000	1,418,000	2,129,000	2,578,000	2,683,000	4,220,000
Pipes and tubes	55,000	122,000	484,000	605,000	891,000	895,000	1,333,000	953,000
Total	3,522,000	6,400,000	11,432,000	10,982,000	16,467,000	29,023,000	22,591,000	15,567,000

Kind of Article.	1900	1901	1902	1903	1904	1905	1906	1907
Electric machinery	309,000	389,000	811,000	837,000	1,266,000	2,455,000	*	*
Locomotive and cars	1,089,000	1,749,000	1,708,000	2,267,000	2,241,000	2,466,000	2,913,000	2,938,000
Spinning machines and parts	810,000	1,279,000	701,000	672,000	830,000	1,469,000	*	*
Steam engines, boilers and machines	1,004,000	1,804,000	1,378,000	1,168,000	2,039,000	4,958,000	20,446,000	30,771,000
Iron nails	2,181,000	1,365,000	1,451,000	1,510,000	1,960,000	2,609,000	2,621,000	3,551,000
Iron rails	4,753,000	1,612,000	1,663,000	2,752,000	1,697,000	943,000	2,216,000	3,828,000
Bars and rods	5,243,000	3,512,000	3,519,000	3,558,000	4,301,000	7,198,000	5,730,000	26,672,000
Pigs, ingots and steel	2,117,000	2,287,000	1,652,000	2,035,000	2,913,000	7,893,000	18,210,000	†4,168,000
Iron plates and sheets	7,078,000	4,178,000	4,197,000	6,088,000	7,800,000	10,305,000	‡	§
Pipes and tubes	2,956,000	1,592,000	1,074,000	1,482,000	1,312,000	2,137,000	1,994,000	3,454,000
Total	27,240,000	17,727,000	18,154,000	22,369,000	26,359,000	40,413,000	36,320,000	75,382,000

* Included under machines and engines.
† Ingots alone, steel included under bars and rods.
‡ Included under pigs, ingots.
§ In bars and rods.

The Russo-Japanese war broke out in February, 1904, and continued till August of the next year, as is well-known. Here again, the imports increased by large leaps, the goods being used mainly for war purposes. Although the people were bitterly disappointed at the Portsmouth treaty because of the failure to secure the much desired indemnity, they showed an admirable courage in the work of extending the manufacturing industries. This is clearly brought out in the curve. In 1907, the imports amounted to 75,000,000 yen ($37,500,000) an increase of 2,000 per cent compared to the amount of 1892.



CURVE SHOWING THE AMOUNT OF IRON GOODS IMPORTED INTO JAPAN, 1892-1907.
In yen; two yen equal one dollar.

Thus far we have traced briefly the general lines of development. Now let us consider the future possibilities. That the iron industry in Japan will continue to expand as it has done may be taken for granted. Will further expansion of home-manufacturing mean exclusion of all foreign goods? Surely not. Then, how much will

TABLE III.

AMOUNT OF IRON GOODS IMPORTED FROM VARIOUS COUNTRIES IN YEN (TWO YEN EQUAL ONE DOLLAR.)

(From the Report of Department of Finance.)

Articles.	*Countries.*	1899	1900	1901	1902	1903	1904	1905
Engines, boilers, motors, generators, lathes, etc.	United States	1,230,000	1,493,000	2,017,000	2,746,000	2,670,000	3,465,000	6,694,000
	Great Britain	2,046,000	3,263,000	4,232,000	3,192,000	2,983,000	5,025,000	6,772,000
	Germany	326,000	226,000	177,000	334,000	326,000	724,000	1,937,000
	Other countries ...	105,000	80,000	149,000	34,000	179,000	78,000	136,000
Bars, plates, rods, rails, nails, pigs, etc.	United States	1,994,000	3,304,000	1,322,000	801,000	1,617,000	1,724,000	2,222,000
	Great Britain	7,458,000	12,642,000	7,395,000	8,797,000	9,669,000	10,678,000	18,510,000
	Germany	1,290,000	3,745,000	3,949,000	3,303,000	4,595,000	3,871,000	4,053,000
	Other countries ...	3,295,000	8,033,000	4,182,000	2,705,000	3,276,000	5,157,000	10,494,000

foreign importers suffer from the competition of the native manufacturers? To this question no definite answer can be given, at least by me. The past history of Japan tells us that, as home manufacturing expands, imports increase in direct ratio. This would be the case for some time to come. In certain lines of work it is impossible for the Japanese to compete with foreign producers. For instance, in iron-smelting work there is no danger of home-made articles replacing the imported ones. A small blast-furnace plant, with men of little experience and ore imported from the far-off interior of China, cannot compete with gigantic American plants, managed by the ablest financiers and engineers of the age. The same thing may be said of large machines. If I am not mistaken, the largest dynamo built in the Shibaura Iron Works, which has the best equipped department for the manufacture of electrical machines, was 500-kilowatt capacity. The home iron industry will grow, and at the same time importation of iron goods will increase, though the character of the goods may change gradually.

Now let us go a step further and see what chances there are for American manufacturers. America, the country which has been friendly in times of war as well as in times of peace, is honored and respected by the people of the island empire. I cannot say what tangible effect this feeling has on ordinary business transactions. It is very likely that the Japanese will buy from Americans provided the latter can offer their goods at no higher price than their European

competitors. The table opposite* (Table III) shows the amount of business done by various countries in past few years. In the importation of machinery the United States is gaining much faster than other countries, as shown in the table. From the general trend of past few years, I feel that I am justified in saying that in 1906 and 1907 America must have been ahead of Great Britain. In the importation of bars, plates, rods, etc., the latter is leading, closely followed by Belgium. It is a strange fact that American manufacturers have not exported these articles, except nails, whose yearly importation usually amounts to over a million yen. I can see no reason why Americans have been so inactive in this line. At any rate it does not seem to be a very hard task for the manufacturers of the United States to take the bulk of the business in this market into their own hands if they try it with their characteristic "push."

Lately foreign manufacturers seem to have realized the advantage of utilizing the cheaper Japanese labor, and at the same time avoiding the Japanese tariff duty†, which is an obstacle in competing against the home manufacturers. The scheme is to build factories in Japan. The articles for the Eastern countries are to be made there in these factories. The British-Japanese syndicate for the smelting plant, as already stated, is an example. A branch shop of one of the largest electrical machine manufacturers in America is also being built now. As far as I can see, there is no reason that these factories should not be successful.

The people of Japan realize the fact that the fast increasing population cannot be supported by agricultural industry alone; they want to make Japan a manufacturing country. Therefore, the expansion of iron industry in Japan will continue. At the same time importation of iron goods will increase. Japan cannot make everything; division of labor is essential in all modern industries. Here is, then, a promising market, to which the United States is nearer than any of the countries participating in supplying this market, and the people of Japan are very friendly toward Americans. These advantages mean a great deal. For those interested in the Eastern market the whole matter is worth serious considerations.

* Compiled from the report issued by the Department of Finance.

† The Japanese tariff duty is 25 per cent on machines.

TABLE 1. ESTIMATED COSTS PER HORSE POWER OF STEAM POWER PLANTS COMPLETE, SIMPLE CONDENSING.

Horse power of engine	10	12	14	15	20	30	40	50	75	100
Steam per horse power per hour, lb.	55.9	52.1	48.7	47.3	44.2	39.	36.2	33.	31.1	28.2
Coal per horse power per hour, running time, lb.	6.1	5.9	5.7	5.25	4.80	4.60	4.20	3.75	3.40	3.10
Total coal per horse power per hour, lb.	7.0	6.75	6.50	6.02	5.50	5.25	4.75	4.25	3.70	3.50
Boiler, including setting	$35.50	$33.10	$29.60	$28.50	$25.10	$20.50	$17.80	$15.80	$14.80	$14.20
Flues	2.28	2.28	2.28	2.28	2.20	2.15	2.10	2.05	2.05	2.00
Stack	12.	10.70	9.70	9.40	8.50	6.30	5.70	5.25	4.80	4.55
Feed pumps	5.70	5.70	5.70	5.70	5.40	3.80	3.10	2.75	2.10	1.70
Engine and condenser	57.	54.	50.	48.	41.50	32.50	27.50	24.20	19.60	17.60
Engine foundations	8.50	8.38	8.30	8.10	7.80	7.40	7.	6.70	6.	5.70
Piping	11.20	11.	10.70	10.20	9.50	8.	7.70	7.30	6.10	5.70
Heaters	2.95	2.75	2.70	2.65	2.50	2.30	2.17	2.10	1.98	1.80
Boiler house	33.70	29.60	27.50	26.20	21.60	18.20	16.	14.80	11.30	9.70
Engine house	14.40	12.60	11.30	10.90	8.60	7.75	6.40	5.35	4.90	4.30
Coal pocket	19.	17.90	16.60	15.80	13.60	11.	8.70	8.50	6.30	5.70
Incidentals	18.	17.60	17.	16.60	14.70	11.80	10.90	10.30	8.70	7.80
Total cost per horse power	$220.	$204.	$192.	$186.	$163.	$134.	$120.	$108.	$93.	$81.

TABLE 2. YEARLY COSTS OF STEAM POWER, 308 DAYS, 10 HOURS PER DAY, SIMPLE CONDENSING.

Horse power of engine	10	12	14	15	20	30	40	50	75	100
Total coal per horse power per hour, lb.	7.	6.75	6.50	6.02	5.50	5.25	4.75	4.25	3.70	3.50
Cost of plant per horse power	$220.	$204.	$192.	$186.	$163.	$134.	$120.	$108.	$93.	$81.
Fixed charges on plant at 11 per cent.	242.	270.	295.	307.	360.	440.	530.	590.	765.	890.
Cost of coal at $5 per long ton	480.	560.	625.	670.	750	1040.	1310.	1470.	1910.	2420.
Attendance	178.	190.	202.	210.	238.	297.	350.	405.	535.	670.
Oil, waste and supplies	22.80	24.80	26.70	27.60	32.50	43.	53.	64.	89.	114.
Total yearly cost, coal at $5 per ton	923.	1045.	1149.	1215.	1380.	1720.	2243.	2529.	3299.	4094.
" " " " " $4 per ton	830.	940.	1030.	1100.	1240.	1550.	2020.	2270.	2961.	3700.
" " " " " $3 per ton	730.	820.	900.	960.	1080.	1360.	1770.	2010.	2600.	3250.
Yearly cost per h.p. coal at $5 per ton	92.30	87.	82.	80.	69.	57.	56.	51.	44.	41.
" " " " " " $4 per ton	83.	78.	74.	72.	62.	51.	50.	46.	39.40	37.
" " " " " " $3 per ton	73.	68.	65.	63.	54.	44.50	43.50	40.	34.50	32.50

One man attends engine, fires boiler and is supposed to do other work besides. On the 10 horse power plant one-fourth of his time is charged to attendance, and three-fourths of his time on the 100 horse power plant.

THE COST OF POWER IN SMALL UNITS.

By Wm. E. Snow.

Data of actual costs, either of installation or operation, are notoriously hard to secure, and are correspondingly valuable when they can be had. Mr. Snow's figures are obtained from many actual installations of small plants in various parts of the United States. They were secured by him personally in the course of years of experience as engine expert. These costs of small units, particularly scarce and difficult of access, should be of permanent interest for reference and comparison by purchasers, owners, and operators.—THE EDITORS.

WHEN a new installation is contemplated there are many questions that arise in the mind of the user of power. Having decided as to the size of unit required, he will want to know the cost of the engine, boiler, flues, stack, feed pumps, heaters, piping, boiler setting, engine foundations, engine house, boiler house, and coal pocket. He will also want to know the steam consumption of the engine, whether it is best to operate condensing or not, and the cost of attendance. As actual figures relating to these details are somewhat difficult to obtain, the following tables will be found useful in estimating upon this class of work. These tables give the general averages of data obtained in over thirty small power plants located in different parts of the United States, and the figures given will be found accurate and reliable for present conditions, having been very recently obtained.

Table 1 shows the complete cost of power plants equipped with simple, condensing engines ranging in size from 10 to 100 horse power, and also gives the cost per horse power of all apparatus and buildings. Table 2 shows the yearly cost of operation, with coal at various prices, of the power plants given in Table 1.

Table 3 shows the complete cost of power plants equipped with simple, non-condensing engines, boiler and engine combined, ranging in size from 2 to 12 horse power, and also gives the cost per horse power of all apparatus and buildings. Table 4 shows the yearly cost of operation of the power plants given in Table 3.

Table 5 shows the complete cost of power plants equipped with simple, non-condensing engines, engine and boiler independent, ranging in size from 10 to 75 horse power, and also the cost per horse power of all apparatus and buildings. Table 4 shows the yearly cost of operating, with coal at various prices, the plants given in Table 5.

TABLE 4. YEARLY COSTS OF STEAM POWER, 308 DAYS, 10 HOURS PER DAY, SIMPLE NON-CONDENSING.

Type of engine	Engine and Boiler Combined.						
Horse power of engine	2	3	4	6	8	10	12
Total coal consumption in lb. per h.p. hour	13.	10.5	8.5	7.9	7.6	7.4	7.25
Cost of plant per horse power	$200.	$152.	$133.	$110.	$89.	$83.	$78.
Fixed charges on plant at 11 per cent	44.	50.	58.20	72.50	78.20	91.50	102.
Cost of coal at $5 per long ton	180.	215.	235.	325.	420.	510.	600.
Attendance	99.	109.	116.	136.	154.	173.	184.
Oil, waste and supplies	13.20	14.30	15.40	17.60	20.	22.	23.80
Total yearly cost, coal at $5 per ton	336.	388.	424.	550.	672.	796.	910.
" " " " " $4 " "	300.	345.	385.	495.	610.	720.	810.
" " " " " $3 " "	265.	300.	340.	430.	530.	630.	710.
Yearly cost per h.p., coal at $5 per ton	168.	130.	106.	92.	84.	79.6	76.
" " " " " $4 " "	152.	116.	95.	81.	76.	72.	68.
" " " " " $3 " "	132.	102.	83.	72.	66.	63.	59.

Type of engine	Engine and Boiler Independent.								
Horse power of engine	10	12	14	15	20	30	40	50	75
Total coal consumption in lb. per h.p. hour	7.4	7.25	7.0	6.5	6.0	5.5	4.75	4.5	4.0
Cost of plant per horse power	$210.	$194.	$182.	$174.	$153.	$126.	$107.	$96.	$79.
Fixed charges on plant at 11 per cent	230.	255.	280.	285.	337.	415.	475.	525.	650.
Cost of coal at $5 per long ton	510.	600.	675.	690.	830.	1100.	1310.	1540.	2050.
Attendance	173.	184.	194.	202.	230.	287.	338.	390.	520.
Oil, waste and supplies	22.	23.80	25.80	26.50	31.20	41.50	51.	61.50	86.
Total yearly cost, coal at $5 per ton	935.	1063.	1175.	1203.	1428.	1843.	2194.	2516.	3306.
" " " " " $4 " "	840.	960.	1050.	1080.	1260.	1660.	1960.	2250.	3000.
" " " " " $3 " "	740.	830.	920.	950.	1100.	1450.	1710.	1960.	2650.
Yearly cost per h.p., coal at $5 per ton	93.50	88.	83.	80.	71.	60.	55.	50.	44.
" " " " " $4 " "	84.	79.	74.	72.	64.	54.	49.	45.	39.
" " " " " $3 " "	74.	68.	64.	62.	56.	47.	42.	39.	34.

Table 6 shows the complete cost of power plants equipped with compound condensing engines, ranging in size from 100 to 200 horse power, and also gives the cost per horse power of all apparatus and buildings. Table 7 shows the yearly cost of operation, with coal at various prices, of the power plants given in Table 6.

TABLE 3. ESTIMATED COSTS PER HORSE POWER OF STEAM POWER PLANTS COMPLETE, SIMPLE NON-CONDENSING; BOILER AND ENGINE COMBINED.

Horse power of engine.	2	3	4	6	8	10	12
Steam per horse power per hour	.....	.....	.....	.....	.....	.....	.....
Coal per horse power per hour, running time....	.....	.....	.....	.....	.....	.....	.....
Total coal per horse power per hour.....	.....	.....	.....	.....	.....	.....	.....
Boiler, including setting	$146.	$108.	$95.	$77.	$63.	$59.	$57.
Feed pumps.....	.....	.....	.....	.....	.....	.....	.....
Engine	22.80	19.40	17.	14.80	12.60	11.40	10.30
Engine foundations.....	5.70	5.70	4.50	4.50	3.40	3.40	3.40
Incidentals	19.40	13.70	12.50	10.30	8.	8.	8.
*Total cost per horse power	200.	152.	133.	110.	89.	83.	78.

From these tables* the approximate cost of any contemplated installation may be obtained and also the comparative cost of units of different sizes, together with the yearly cost of operation, thereby affording the power user a convenient basis for estimates on this class of work. For example, let us assume that it is desired to install a small power plant of 75 horse-power capacity. The first question that arises is whether it is advisable to operate condensing or not. Referring to Table 1 of simple condensing engines, we find the cost of the plant to be as follows:—

CONDENSING.

75 horse-power engine and condenser.....	$1,475
Engine and condenser foundation.....	450
Boilers and setting	1,100
Flues	154
Stack	360
Feed pumps	158
Piping	460
Heaters	148
Boiler house	850
Engine house	370
Coal pocket	470
Incidentals	650
	$6,645

* These tables were compiled from a large volume of data obtained in many small power stations at various places, with apparatus of all kinds and from divers sources. Without artificial adjustment of averages, it would be impossible to compile, from such materials, a set of tables that should be absolutely concordant at all points. This forcing of differences has not been undertaken. Some discrepancies will be found between the sum of items and the totals given, and between the unit figures used in different places. These are in no case large enough to affect appreciably any purpose of ordinary estimating, for which these approximations are designed, and the natural figures given are thought to be more reliable and to carry a smaller percentage of error than would result from an attempt to bring them into complete apparent harmony.

TABLE 5. ESTIMATED COSTS PER HORSE POWER OF STEAM POWER PLANTS COMPLETE, BOILER AND ENGINE INDEPENDENT, SIMPLE NON-CONDENSING.

Horse power of engine	10	12	14	15	20	30	40	50	75
Steam per horse power hour, lb	64.3	60.1	57.2	55.4	52.3	45.1	42.3	40.2	36.5
Coal per horse power per hour, running time	....	....	....	....	....	....	....	....	....
Total coal per horse power per hour	....	....	....	....	....	....	....	....	....
Boiler, including setting	$56.	$51.	$46.	$43.50	$32.	$26.	$24.	$20.50	$17.30
Flues	2.30	2.30	2.30	2.30	2.25	2.20	2.15	2.10	2.
Stack	16.	14.80	13.40	13.	11.60	8.70	7.30	6.30	5.60
Feed pumps	5.70	5.50	5.50	5.40	5.40	3.80	3.15	2.75	2.10
Engine	36.50	36.	35.50	35.	34.50	28.50	21.50	17.40	15.50
Engine foundations	5.70	5.50	5.40	5.35	5.25	5.15	5.05	4.90	4.60
Piping	8.30	8.	7.60	7.40	6.70	5.70	5.10	4.60	3.90
Heaters	2.96	2.75	2.70	2.60	2.50	2.20	2.15	2.05	1.90
Boiler house	37.50	33.	30.	28.50	24.50	20.50	18.	16.	13.
Engine house	4.80	4.35	4.	3.90	3.30	2.75	2.50	2.30	2.15
Coal pocket	21.	19.40	17.20	16.90	14.80	12.	10.80	9.40	7.
Incidentals	20.	18.	16.	15.	13.70	11.	9.80	8.30	6.
Total cost per horse power	218.	200.	190.	180.	156.	130.	110.	99.	82.

TABLE 6. ESTIMATED COSTS PER HORSE POWER OF STEAM POWER PLANTS COMPLETE, COMPOUND CONDENSING.

Horse power of engine	100	200	300	400	500	600	700	800	900	1000	1500	2000
Steam per horse power per hour, lb	24.1	22.3	20.2	19.5	19.	18.1	17.3	16.2	15.1	14.5	13.9	13.5
Coal per horse power per hour, running time	2.75	2.45	2.40	2.35	2.30	2.25	2.20	2.15	2.10	1.95	1.80	1.75
Total coal per horse power per hour	3.15	2.85	2.75	2.70	2.65	2.60	2.55	2.50	2.45	2.25	2.07	2.02
Boilers, including setting	$8.	$7.60	$7.40	$7.30	$7.25	$7.20	$7.15	$7.05	$6.90	$6.80	$6.60	$6.40
Flues	1.93	1.82	1.59	1.36	1.12	1.02	0.92	0.80	0.68	0.57	0.57	0.57
Stack	4.55	4.	3.65	3.30	3.08	2.95	2.90	2.85	2.80	2.75	2.70	2.68
Feed pumps	0.93	0.57	0.46	0.37	0.31	0.29	0.28	0.27	0.26	0.25	0.24	0.19
Engine and Condenser	25.	24.	23.	22.	21.50	21.25	21.	20.75	20.50	20.25	19.50	19.
Engine foundation	5.70	5.60	5.50	5.40	5.30	5.20	5.10	5.	4.90	4.80	4.40	4.10
Piping	13.80	11.20	9.10	8.	7.40	6.80	6.50	6.25	6.	5.75	5.10	4.55
Heaters	2.85	2.55	2.25	2.	1.75	1.42	1.12	1.12	1.	1.	0.95	0.95
Boiler house	28.50	24.	11.20	8.	6.40	5.70	5.35	5.	4.68	4.55	4.10	3.96
Engine house			11.20	9.35	8.50	7.20	6.20	5.60	5.35	5.	4.75	4.55
Coal pocket	5.70	4.	3.10	2.60	2.40	2.27	2.16	2.05	1.93	1.82	1.73	1.61
Incidentals	9.70	8.	6.80	6.50	6.25	6.	5.75	5.50	5.25	5.	4.75	4.60
Total cost per horse power	106.60	93.30	86.20	76.20	71.20	67.30	64.40	62.20	59.30	55.70	54.40	53.20

Referring to Table 5, of simple non-condensing engines, we find the cost of the plant to be as follows:

NON-CONDENSING.

75 horse-power engine	$1,130
Engine foundation	345
Boilers and setting	1,100
Flues	150
Stack	420
Feed pumps	158
Piping	290
Heaters	142
Boiler house	970
Engine house	160
Coal pocket	525
Incidentals	450
	$5,950

Referring to Table 2, we find the cost of yearly operation of the condensing plant to be as follows:

CONDENSING.

Coal at $5.00 per ton	$1,910
Fixed charges at 11 per cent	765
Attendance	535
Oil, waste and supplies	89
	$3,299

Referring to Table 4 we find the cost of yearly operation of the non-condensing plant to be as follows:

NON-CONDENSING.

Coal at $5.00 per ton	$2,050
Fixed charges at 11 per cent	650
Attendance	520
Oil, waste and supplies	86
	$3,306

These figures show that while the initial cost of the condensing plant is 11 per cent. higher than that of the non-condensing, the gain in economy of operation is very slight, as with an engine of but 75 horse power the proportion of steam used in driving the auxiliaries is comparatively large. For this reason it is not customary to operate power plants of less than 200 to 300 horse power condensing.

TABLE 7. YEARLY COST OF STEAM POWER, 308 DAYS OF 10 HOURS PER DAY, COMPOUND CONDENSING.

Horse power of engine	100	200	300	400	500	600	700	800	900	1000	1500	2000
Total coal per h.p. per hour, lb.	2.75	2.45	2.40	2.35	2.30	2.25	2.20	2.15	2.10	2.00	1.80	1.75
Cost of plant per h.p.	$105.60	$93.30	$86.20	$76.20	$71.20	$67.30	$64.40	$62.20	$59.30	$55.70	$54.40	$53.20
Fixed charges on plant at 11 per cent	1160.	2060.	2850.	3350.	3920.	4451.	4952.	5492.	5910.	6130.	9000.	11880.
Cost of coal at $5 per long ton	1910.	3370.	5100.	6700.	8380.	9650.	11000.	12500.	14300.	14500.	18600.	24200.
Attendance	880.	1220.	1220.	1760.	1930.	2100.	2650.	2700.	2930.	3480.	4400.	5200.
Oil, waste and supplies	143.	205.	240.	285.	315.	350.	385.	420.	445.	470.	600.	685.
Total yearly cost, coal at $5 per ton	4198.	6948.	9496.	12171.	14596.	16618.	19050.	21674.	23644.	24595.	35100.	42018.
Total yearly cost, coal at $4 per ton	3780.	6200.	8550.	11000.	13200.	15700.	17200.	19500.	21200.	22200.	31500.	37800.
Total yearly cost, coal at $3 per ton	3300.	5400.	7500.	9700.	11500.	13200.	15200.	17100.	18500.	19500.	27500.	33000.
Yearly cost per h.p., coal at $5 per ton	42.20	35.10	31.50	30.50	29.20	27.70	27.30	26.10	25.20	24.50	23.50	21.
Yearly cost per h.p., coal at $4 per ton	37.80	31.50	28.40	27.	26.10	24.90	24.60	23.50	22.60	22.	20.30	18.90
Yearly cost per h.p., coal at $3 per ton	33.20	27.70	25.	23.80	23.	21.90	21.50	20.60	19.90	19.40	17.90	16.60
	1 Man $16 per week	1 Man $16 1 Man $7	1 Man $16 1 Man $7	1 Man $16 1 Man $10 1 Man $7	1 Man $16 1 Man $13 1 Man $7	1 Man $17 1 Man $13 1 Man $10	1 Man $17 2 Men $22 1 Man $10	1 Man $18 2 Men $22 1 Man $10	1 Man $18 2 Men $25 1 Man $10	1 Man $19 2 Men $26 2 Men $20	1 Man $22 3 Men $36 2 Men $20	1 Man $25 4 Men $50 2 Men $20

EXHAUST-STEAM VERSUS LIVE-STEAM HEATING.

By Charles A. Howard.

The argument as to the economy of heating boiler feed by live steam, ably maintained both on the affirmative and the negative, is active at present. A very interesting discussion in *The Engineer* is abstracted in our Review of the Engineering Press, elsewhere in this issue. Mr. Howard's criticism has been submitted to Professor Reeve for comment, and his rejoinder and Mr. Howard's summing up are presented here in immediate sequence.—THE EDITORS.

THE scheme proposed by Professor Reeve in THE ENGINEERING MAGAZINE for March, for heating the feed water in power plants, can be reduced to two fundamental points:—first, is live-steam heating productive of any greater economy than the present system, and second, does the method proposed, that of running the auxiliaries of the plant under a high back pressure, give any advantage over heating the feed directly by live steam from the boiler itself?

The danger of oil passing through the open heater into the boilers, which seems to be the strongest argument against the open heater, is easily avoided when the piping is of the proper design and a good oil separator is used. I say "a *good* oil separator," because there are a large number of oil separators on the market which do not separate; but there are several good ones which practically prevent the passage of any oil. I know of one large plant of water-tube boilers using open heaters entirely for feed heating, the steam coming from auxiliary engines, where only four tubes per boiler per year have been replaced, and most of these renewals have been due to the fact that the tubes were originally defective. These boilers are cleaned about once per year and no effects of oil have been noticed.

Thermodynamically, leaving out of the question for a moment that there is an economizer in the system, there is no greater economy secured by feeding the boiler with water at the steam temperature than can be had at a lower temperature.

The sources of loss in a boiler are as follows: 1, loss due to incomplete combustion; 2, loss due to combustible in the ash; 3, loss due to heat in the flue gases; and 4, loss due to radiation.

It seems pretty clear that none of these losses can be minimized by the introduction of water at steam temperature. This is shown in practical operation by the following test which was very carefully

made in order to determine the economy of live-steam heating. The tests were made on two consecutive days, the live-steam heater being used the first day and cut out the second. The coal used on both tests was from the same pile, and to make sure that equal quality was used on both tests, it was weighed up in 100-pound bags and every alternate bag was used on the first test, the remaining ones being used on the second test. The water was measured in calibrated tanks.

Test of	Dry-back tubular boiler
Made by	Prof. Goodman, University of Leeds
Location	Leeds, England
Date	July 4 and 5, 1907
Purpose	Find the economy of live-steam-heating
Coal	Wombwell Steam
Draft	Induced
Method of starting test	Alternate
Duration	12 hours each

Observation.	With heater.	Without heater.
Coal fired per hour, lb. (dry)	572	563
Steam, pressure gauge	98.7	97.2
Feed temperature	325 degrees F.	124.8 degrees F.
Steam temperature	337 "	335.8 "
Temperature gases leaving boiler	488 "	482 "
Equivalent evaporation per lb. dry coal from and at 212 degrees F	9.96 lb.	10.02 lb.

The above test, which is probably as accurate as the best of boiler tests, substantiates the previous theoretical deductions and indicates with a considerable degree of precision that there is no direct saving due to live-steam heating. While the means advocated by Professor Reeve for heating the water are radically different from those used on this test, that makes no difference, as we are interested for the present moment in obtaining the steam temperature of the water irrespective of the method, regarding which more will be said later.

Of course when economizers are used, if they are fed with cold water, the amount of heat carried away in the gases is reduced and the boiler efficiency correspondingly increased. This is true, however, whether or not live steam is used for heating, so that it is independent of the real subject.

The system proposed of running the auxiliaries under a high back pressure and exhausting through a closed heater, at a temperature near that of the boiler steam, is open to a great many objections. First, it introduces the closed heater, which except under exceptional conditions has many disadvantages as against the open heater with only a slight pressure within it.

The condensed steam and its heat are thrown away in the closed

heater, often amounting to one-eighth of the total feed water; and being at a temperature ranging from 200 to 350 degrees F., depending upon the pressure carried in the heater, this represents a considerable loss.

When the feed water is at all bad (and it never is too good) certain salts are precipitated which are taken care of in the open heater, but which cause an accumulation of scale on the tubes of the closed heater. This scale, together with the deposit of oil which is always found on the steam side of the tubes (unless a separator is used, which is usually considered unnecessary with a closed heater) will cause a large reduction in capacity and efficiency.

The heater is under high pressure; and the failure of a tube, which is a frequent occurrence, makes it necessary to by-pass the heater.

Besides involving the closed heater, this system requires that all the exhaust piping of the station shall be for high-pressure service, causing greater first cost and maintenance. Professor Reeve makes the statement that "the pump will work in one sense at its best thermodynamic efficiency when its exhaust temperature is close to its admission temperature." I judge that he means the efficiency of the pump as a pump and heater combined, as considering only the mechanical work done by the pump, the reverse of his statement is true. As a pump and heater combined, the only heat lost in the atmospheric exhaust system using an open heater is that due to radiation from the piping. In the pressure exhaust system, this radiation will be nearly twice as great as in the atmospheric system; and besides this, only the heat of vaporization of the steam is returned to the feed water, leaving the heat of the liquid at about 350 degrees F. or greater which is lost as the condensate in the closed heater.

The question of decreased wear on the boilers due to the introduction of the feed close to the steam temperature instead of at 210 degrees F. is problematic and doubtful. The strains which are hardest on a boiler are those which occur in firing up, due to variations in temperature much greater than those which are present during the normal operation, and it would hardly seem that the increase of a hundred degrees in the feed-water temperature would reduce the strains to any extent where the temperature of the gases will be anywhere from 700 to 2,800 degrees F.

There is no advantage in feeding the boilers with steam-hot water, and it does not appear to me that the plan suggested by Professor Reeve is as convenient or as efficient as live-steam heating, when the feed is first heated by the exhaust steam of the auxiliaries in an open heater.

THE SUBSTANTIAL ADVANTAGES OF STEAM-HOT FEED WATER.

By Sydney A. Reeve.

A REJOINDER TO THE CRITICISM OF MR. HOWARD.

MR. HOWARD closes his paper with the dogmatic statement that "there is no advantage in feeding the boilers with steam-hot water."

This is a statement very hard to substantiate. It is not sufficient to establish that some one boiler plant, such as that at Leeds, has not been aided thereby; for there has never been contention, I believe, that *all* boilers would be aided by steam-hot feed. It could never be urged that all boiler plants would be aided by any one of the many devices and policies which are found profitable under one set of conditions or another.

The belief that steam-hot feed aids the circulation, the life, the capacity and even the efficiency of most forms of shell boilers, and perhaps of some water-tube boilers, is widespread. I have not offered to uphold this belief. I should have great hesitancy in denying it. It is like the belief that is well-nigh universal among locomotive engineers, that a locomotive boiler taken from its wheels and used for stationary service will never make anything like the same quantity of steam, nor with the same efficiency, that it did on the rails. Can anyone deny that belief? A single instance of such change in action with removal of the wheels serves to establish the insufficiency of Mr. Howard's beautifully simple list of all the factors in boiler action, as four in number, and to uphold the faith of the railroad men. An hundred instances of failure to detect such change do not suffice to deny its frequent occurrence.

Mr. Howard says that of course, if the economizers are fed with cold water, the plant will be more efficient; but that this is independent of live or exhaust feed-heating. But is it? If the pump and auxiliary exhausts are utilized for heating pre-economizer water in open heaters, whence is the cold-water supply for the economizers to come? If the pumps and auxiliaries leave the water cold for the economizers to utilize, how about the heat losses in their exhausts?

Finally, if other and more efficient means for pumping than direct-acting non-expansive pumps are what Mr. Howard has in mind, why are they so very seldom used? They are used in England, and probably were at Leeds. But my article was premised upon the accepted American practice of using wasteful types of feed pumps, the question being merely: Shall we do our throttling of pump steam (which is always done anyhow) more profitably upon the supply or upon the exhaust?

Mr. Howard's objection to live-steam heating because it involves "closed" (and therefore tubular?) heaters is a tilt at a wind-mill. The one district of this country (the valleys of the upper Mississippi and Ohio) which affords the vilest water for boiler-feed, heavily charged with sulphates of lime and magnesia, relies almost exclusively upon a heater under pressure where the steam and water mingle freely, which possesses no tubes. But even if a tubular heater were to be used, his objections to it are imaginary. There is no difficulty in saving both the substance and the heat of the pump exhaust. With any of the coiled tubular heaters, and some of the straight-tube heaters, leaky tubes are virtually unknown.

It is to be hoped that it may be realized that such a suggestion as I offered, like any other suggestion in power-plant design, may be out of the question for many particular cases and may yet be of substantial value in many others—if used with that sense and discretion which is always indispensable in engineering affairs.

Mr. Howard, being invited by the Editors of THE ENGINEERING MAGAZINE to close the discussion, replies as follows:

The objections which Professor Reeve takes to several of the minor points of my paper are very indirect and without basis, and he has not directly opposed any of my statements. The following instance is indicative of the remainder:

He states the "belief" in regard to the locomotive boiler steaming better on wheels than in stationary service, but he does not anywhere say that it is his own belief. Does he give any of the boiler losses which he insinuates (not states) that I have omitted? It will be noticed that I have made no mention of "more efficient means for pumping than direct acting non-expansive pumps" which Professor Reeve seems to think that I have in mind.

He admits that he does not uphold that steam-hot feed aids the circulation, the life, the capacity and the efficiency of the boiler. This granted, it is apparent that there can be no gain, either theoretically or practically, by throttling the exhausts of the auxiliaries, which is an imperfect method of attempting to produce steam-hot water.

THE IMPORTANCE OF ENGLISH IN THE WORK OF THE ENGINEER.

By William D. Ennis

THE root-idea of engineering is *form*. The engineer's work is to form, to inform, to conform; to reform, to formulate, to perform. He makes hidden things visible; he transmutes universal natural law into specific serviceable force. After the Architect of the universe, he gives form to that which was without form and void.

To present ideas as words is one of the vital phases of engineering. Pure abstractions are the subject matter of technology; their formulation in adequate and accurate language makes them the subject matter of commerce. The language of the engineer must be so clear that he who runs *must* read. His statements must appeal to the eye and mind—not challenge vision and perception by careless arrangement and faulty diction. Let two men write reports from the same data; one report will flash its meaning upon the reader; the other will bewilder him. The difference is of language.

The average matriculate of any college is highly illiterate. The freshmen in technical schools are no better. The graduates cannot spell. One young man, a year after graduation, habitually spelled incorrectly the names both of his firm and of his superintendent. We find gross errors in orthography and punctuation even in the titles of drawings, which must have challenged the attention of a half-dozen non-observers. Possibly these things result from taking too seriously the dictum of Professor Child:

> "One of the most useful things just now is to break down the respect . . . . . for the established spelling. . . . . I don't much care how anybody spells, so (*sic*) he spells different (!) from what is established."

There is a bland conceit in the usual technical or professional curriculum. It assumes that which it knows very well is not true, that is, that students enter professional schools after having received a fairly broad and thorough general education. Consequently, if any general branches are taught, it is in an apologetic and half-hearted manner, at such times and under such circumstances as may be provided after all professional studies have been fully taken care of.

This is like the practice first noted by Lemuel Gulliver, of constructing buildings from the roof downward, in imitation of the spider.

This article can offer no practical suggestion for increasing the digestive capacity of adolescent minds. Technical curricula are already overcrowded. Further demands must lead to further specialization, to extension of the course, or to more advanced preparatory training. The first outcome, while perhaps unfortunate, seems inevitable; the other two would advance the age of graduation and entrance upon professional life. However we choose to surmount the three-pronged dilemma, we must inevitably provide *somewhere* in the preparatory or the technical course, the means of acquirement of what has been specified as one of the evidences of an adequate education—fluency and precision in the use of the mother tongue.

There is a prevalent though wholly erroneous notion that the vocabulary necessary for the engineer is a narrow one—that to obtain sufficient command of that vocabulary is easy—that so long as one has some valuable fact to announce, it matters little how it be announced. But the vocabulary of engineering is broad, involving the use, not so much of a vast number of purely technical terms, as of a wide range of common words to express adequately the involved ideas that are presented. Passages of approximately equal length from various sources show the following extent of vocabulary:

Editorial article in the New York *Sun*	189 words;
News item	175 words;
Part of an epistle of St. Paul	158 words;
Shakespeare (Mark Antony's oration, *in verse*)	169 words;
Mr. Webber's article in THE ENGINEERING MAGAZINE, November, 1906	198 words;
Another recent technical article	184 words;
Still another practical article on steam boilers	198 words;

Evidently, therefore, the vocabulary of the engineer is not quite as bare as we are accustomed to think.

Accuracy in the use of words is the evidence and the outcome of accuracy in the operations of the mind, and should therefore be a part of the equipment of the engineer. Of course, this equipment is often independently obtained, with the progress of time. Men of scant educational training sometimes speak and write with appropriateness and dignity. So also is engineering work of the highest character produced by men who have not profited by early training in the technical school. These results are obtained not because of the absence of educational opportunities, but in spite of that absence. We have found the results to be more quickly and generally obtainable under the additional advantages of technical training, which

should enable the young man more quickly to become a good engineer, and also to possess, from the start, something of

"the divine art of using words."

English studies—the language, its form and history—the literature, and logic, should give to the student the faculty for marshaling data; for arranging isolated facts in such due order and relation to one another, that comprehension will be compulsory. Men of affairs are busy; they must have all information presented in readily assimilable form. The engineer himself passes to new problems, different activities. In referring to his past work, he needs that the results shall stand out clearly so that the desired fact may be found without a second research.

A well written engineering paragraph may be good literature. The diction is pure; words have a fixed and unmistakable significance; without effort, we arrive at the exact meaning. A badly written passage is no less torturing in a technical treatise than in a novel. Take, for an example of exact diction, the following passage:—

> "A curve is obtained which approximates much more nearly to a straight line than the corresponding curve of heat or water consumption per hour per horse-power, and for this reason it can be plotted with greater accuracy when there are but few experiments." . . . . .

This is good standard English. We may find equally crisp language in Rankine:—

> "The tension of the wire is increased step by step, by successive augmentations of the load within the limits of permanent elasticity, and the elongation is observed at each step. Then by successive diminutions of the load, the tension is diminished by the same series of steps in the reverse order, and the elongation observed."

The operation described is pictured to the mind's eye by so straightforward an account as this. Another commendable example, from Darwin:—

> "These latter reefs have been formed while the land has been stationary, or, as appears from the frequent presence of upraised organic remains, while it has been slowly rising: atolls and barrier reefs, on the other hand, have grown up during the directly opposite movement of subsidence."

Good taste in language is a mark of good taste generally. Engineering involves not only the observation and discrimination of facts, and action from conclusion based on facts, but action at proper times, in proper manners, and in proper relation to other facts. Good taste in the use of English is as often violated in engineering publications as in other literary products. The better type of engineering essay, as exemplified by many writers, is characteristically matter-of-fact. There is no elation over what has been said or accomplished; but

rather a steady purpose to explain, to instruct, up to the last word. This is the disposition shown in a well-known handbook:

> "The contents of this Part consist of a general survey of the subject of cranes, including an enumeration of the principal forms in which they are used, a definite system of nomenclature applied to the various forms, and finally a study of the most important elements of mechanism employed in crane construction."

We may perhaps excuse a Rankine for a bit of "fine writing" after the completion of his "Applied Mechanics":

> ". . . . . the engineer or the mechanic, who plans and works with understanding of the natural laws that regulate the results of his operations, rises to the dignity of a sage."

We cannot, however, fail to prefer the steady purpose to impart knowledge rather than to sit in self-congratulation, that animated Regnault, in the last phrases of his paper describing the fragmentary data on the properties of vapors, left available after the catastrophes of 1870-71:

> "De plus, on est sûr d'obtenir un gaz très-purgé d'air, ce que l'on peut à peine espérer avec nos flaçons remplis de matières poreuses."

Neither can we fail to contrast with Rankine's one ebullition the patient anxiety for clearness of Spencer:

> "The relation of this work, to works preceding it in the series are such as to involve frequent reference. Containing as it does, the outcome of principles set forth in each of them, I have found it impracticable to dispense with restatements of those principles. . . . . I do not, however, much regret this almost unavoidable result; for only by varied iteration can alien conceptions be forced on reluctant minds."

Besides inculcating the use of pure and appropriate English, the training of the engineer should give him such exercise in the use of his powers of reasoning and analysis, as no amount of purely mathematical training can furnish. Let some never-so-knobby-brained mathematician undertake the simple task of abstracting a plain, descriptive technical article down to a predetermined compass, omitting no essentials. He will find it vigorous mental exercise.

This particular form of intellectual effort, with concurrent attention to classic literature in the vernacular, should give to the student some relief from that narrow and topsy-turvy view of the proportions of things that is so often characteristic of the young technical graduate or undergraduate. No subject is more essential to success than training in the knowledge of human nature. Good literature, in the absence of the "earnest strife of life," can do much to impart a correct view of men's reciprocal rights, privileges, and duties, and a just estimate of human values. To follow the workings of another man's mind is always a broadening thing.

The English course in the technical curriculum should be an important one—helpful to the other courses, attractive to the student, and by no means a non-essential. As to methods, there are so many that only the briefest suggestion can be made. In the English department, the student should begin to follow the advice of Nystrom:—

> "Every engineer should make his own pocket-book, as he proceeds in study and practice, to suit his particular business."

From the day of matriculation, the student should begin the accumulation of data. Some of it, even under supervision, may turn out to be rubbish; but he will at least have learned how to accumulate; how to be, not a bucket, but a sponge. Modern commercial systems may be adopted for classifying and filing. Practice in abstracting technical papers may in part take the place of the usual "essay writing" of a liberal training. Appropriate methods of writing specifications should be taught, including some infallible system for not "leaving anything out." In addition, let the student learn how to write (or give verbally) a shop or construction order. Many an engineer cannot write an appropriate notice regarding hours of labor. In fact, some of the best shop bulletin productions, from a literary and practical standpoint, are the work of ungrammatical and uneducated shop foremen who know how to say what they mean.

The engineering publication of the college, if it issue one, should be more or less directly supervised by the English department, with actual co-operation, in turn, by all the students. Some advantage might also be taken of the existence of an engineering club or scientific society. Students should be required to follow a standard practice in engineering abbreviations and symbols, and to apply that practice to their work in all departments. They should have exercise in the preparation of technical reports on their laboratory and testing work, of accounts of inspection trips, and the like. Let them get the atmosphere of engineering work about them early.

It would be useful to have the current technical magazines regularly reviewed, under supervision. The information thus obtained, when properly condensed, could form the basis of a card index for the use of the faculty and the students generally, and would also constitute a part of the student's embryo handbook.

It was the argument of Comenius that the proper education of the mind should comprise, last of all, the training of the critical faculties. The general education of the student is not complete until he can distinguish between what is mentally good and what is mentally evil. The study of English in the technical school should train this critical faculty.

PORTER COMPRESSED-AIR LOCOMOTIVE, LUMBER YARDS OF INTERNATIONAL HARVESTER CO.'S McCORMICK PLANT.

Cylinders 7 by 12, gauge 30 in., weight 13,000 lbs. H. K. Porter Co.

HOISTING MACHINERY FOR THE HANDLING OF MATERIALS.

By T. Kennard Thomson.

III. SHOVELS, DREDGES, AND SPECIAL UNLOADERS.

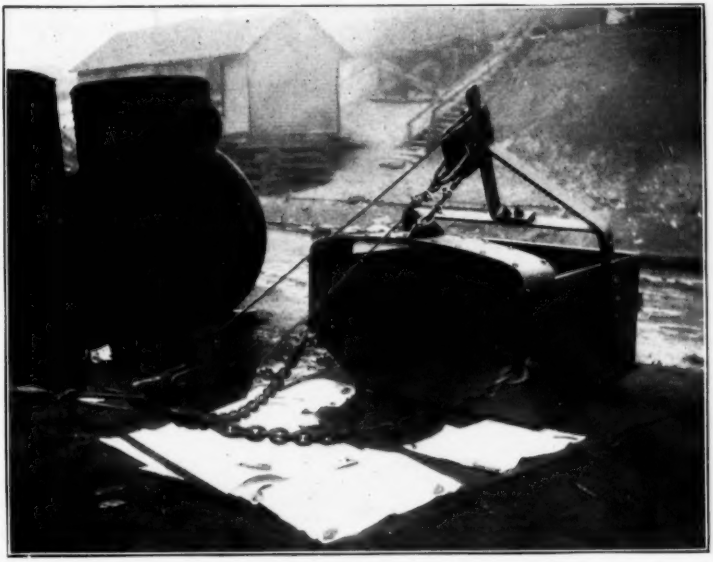
Mr. Thomson here concludes his study of handling machinery, which began in the issue of THE ENGINEERING MAGAZINE for March last. The preceding parts have covered the influence which such appliances exercise in lowering unit costs, the forms especially suited to excavation and construction work, and cranes, cableways, and transporting conveyors.—THE EDITORS.

IN the many forms of good buckets in use—the "clam-shell," "orange-peel," bottom-dump and trip buckets, are a multitude of variations of design and size, the latter running from ¼ cubic-yard capacity up to 8 or 10 yards, not to mention the big 10-ton automatic ore unloaders. A simple form of bucket used almost universally in caisson work is 29 inches in diameter and about 3 feet high with a hinged bale or handle, and a ring on the bottom to which a snatch line is connected as it leaves the lock; when the snatch line is held tight and hoisting line slackened the bucket, of course, turns upside down and deposits its contents where desired. The trip bucket, made in capacities up to 2 cubic yards or more, is so constructed that the bale or handle is clamped to the side in such a way

HEAVY BUCKETS IN EXCAVATING WORK.

Above, a Hayward 3 cu. yd. orange-peel used by Henry Steers, Inc., for filling for the Pennsylvania Railway, Greenville, N. J. It handles pieces up to 5 and 6 tons. Below, an English locomotive crane with Hayward 2 cu. yd. clam-shell bucket, used by S. Pearson & Sons in cleaning a mixture of clay and stone from the roof of the P. N. Y. & L. I. tunnel. The Hayward Co., N. Y.

that when the latch is knocked up with a shovel or hammer the weight of the material in the bucket upsets it just enough to allow the material to fall out; then the empty bucket swings back into a vertical position and clamps itself. These are much used on ordinary derrick work, the 2 cubic-yard size being very common.

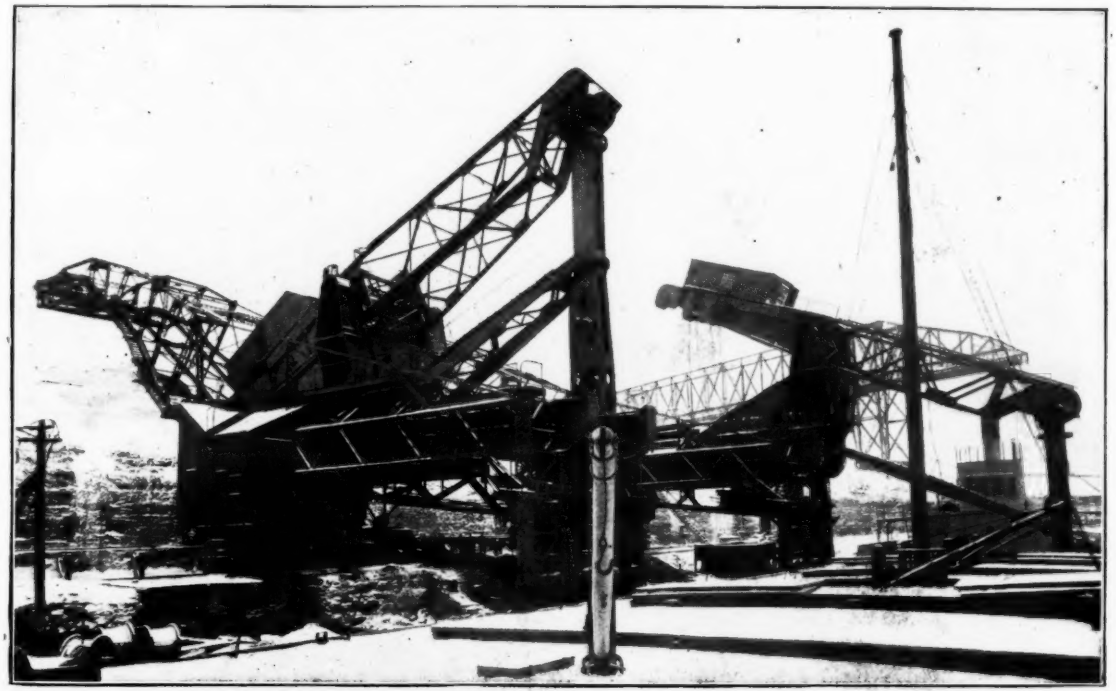


AN EXTRA HEAVY BUCKET.
Used by Page & Schnable.

In New York the laborers or cellar diggers shovel the material into the bucket which the derricks hoist over the wagons, where it is dumped, the wagons being in turn dumped onto scows, making the handling of the cellar excavation run up to $2 or $3 a yard as against 25 cents in the country. Working these buckets should soon show the advantages of the clam-shell, orange-peel, and similar forms which feed themselves, doing away with much expensive labor and the waste of time in waiting for the derrick, and in other delays.

These self-filling buckets have two or more parts which are lowered on to dirt, coal, gravel, sand, ore, etc., with wide-open jaws which shut up as soon as hoisting begins, but not before they have scooped up a full load.

Many mechanical devices are used to operate these jaws, and on the larger sizes pneumatic power is used. A 1 cubic-foot orange-peel bucket costs about $100 and is useful in cramped quarters, such as

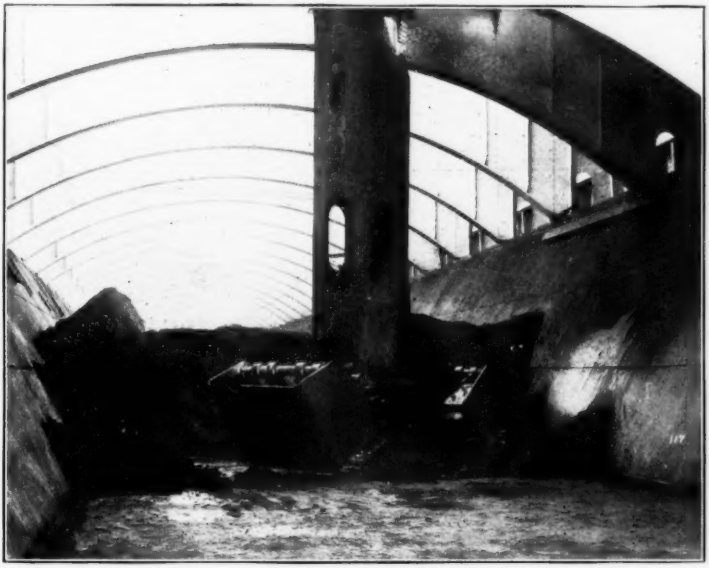


TWO HULETT AUTOMATIC ORE UNLOADERS, WORKS OF THE NATIONAL TUBE CO., LORAIN, OHIO.

They have unloaded an average of 500,000 tons of ore each per season. Cost approximately $90,000, in place. Installed by the Wellman-Seaver-Morgan Co.

digging between piles, etc; $700 will buy a good 1 cubic-yard one, $1,400 a 3 cubic-yard, while an extra-heavy 10 cubic-yard bucket costs as much as $4,000.

Clam shells are a little cheaper; the ½ cubic-yard size being $350, the 1 cubic-yard $480, and the 5 cubic-yard $1,000 to $3,000. These prices may seem excessive, but when compared with the cost of men filling plain buckets they are insignificant. The only apology for stating such self-evident facts is that one can go almost anywhere and see a gang shoveling dirt or other material into a bucket, or waiting for the bucket to come back, and then go around the corner and see the self-feeding buckets or excavators doing the work for a fraction of the cost—though, of course, there are places where nothing but the old-fashioned forms can be used.



UNLOADER LEG AND BUCKET OF HULETT AUTOMATIC UNLOADER IN THE HOLD OF AN ORE VESSEL.

Capacity 10 tons; when open, the bucket covers on area 18 by 18 ft.; can unload 90 per cent. of an ore cargo without help from shovelers. Operated by hydraulic or electric motors.

The highest development so far has been made for ore-handling plants where the bucket is a huge complicated machine by itself, as shown in the illustration of the Hulett automatic ore unloader opposite; for there it is fully realized that every minute saved in unloading a boat is a very important consideration. Here we have a bucket

with a capacity of 10 tons, covering a width of 18 feet when open; and capable (it is said) of unloading 90 per cent of a boat's cargo without the aid of shovelers. It is closed by hydraulic power when steam is used, and by an especial design of motor when electricity is the motive power. In the picture the operator is seen standing in the rigid arm of the bucket itself; so he is always in the right place to see when and where the jaws should be shut. This is a part of one of those immense cranes of the National Tube Company at Lorain, Ohio, where the Lake Boats are unloaded. Two of these machines have unloaded an average of 500,000 tons of ore each in one season. When steam power is used it is supplied from a 175 horse-power boiler of the locomotive type, operating a steam pump capable of supplying the necessary amount of water at a pressure of 1,000 pounds per square inch. Hydraulic cylinders are used to open, close, and rotate the bucket, to move the trolley, and to raise or lower the walking beam. Another engine is used for moving the machine itself along the dock and handling the bucket car. When run by electricity the motors take their current by sliding contact from lines laid along the dock, using 80 horse-power motors for handling the

REVOLVING STEAM SHOVEL IN OPERATION.

Will rotate in a complete circle; with a ¾ cu. yd. dipper, will cut 600-900 cu. yd. in a 9-hour day. Can be converted into a locomotive crane, fitted with clam-shell or orange-peel bucket, provided with timber hooks and used as a log loader, etc.

The Browning Engineering Co.

bucket, 150 horse-power for hoisting the walking beam, and a 50 horse-power motor for trolleying in and out; a 200 horse-power engine is required for moving the machine itself and the bucket car. The controllers are of magnetic type and are naturally built for heavy service. The total cost of one of these ore unloaders is about $90,000.

DITCHER, BUILT TO OPERATE FROM A FLAT CAR OR FROM THE GROUND.
Browning Engineering Co.

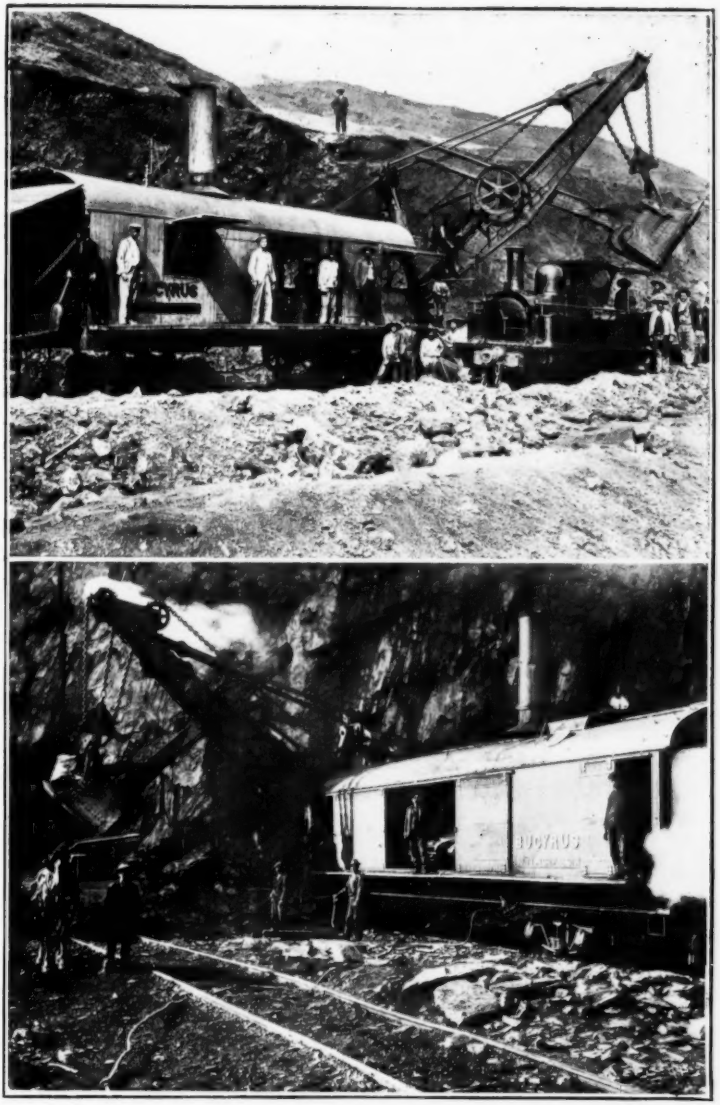
Put a scoop bucket on the end of a movable arm and we have the steam shovel, the first of which was designed by a Mr. Otis of Boston in 1840; his general outline or idea was practically the same as the modern highly finished machine, and though his attempt was very successful it took twenty-five years for the idea to take root. The early shovels were built on a sort of pillar-crane type having the boom rigidly attached to the top of the pillar by heavy bracing, or its equivalent, and it is only within the last twenty years that this has

been superseded by the boom type in which the lower end of the boom is attached to a turn table and its upper end is held by a boom guy fastened to an A frame over the turn table. The height of these A frames has now been reduced so that they can now pass through bridges and tunnels, and in a few cases where higher A frames are desired they are arranged so that they can be lowered.

Contractors are rapidly realizing the fact that the steam shovel is one of the best money makers, and as a result there is such a demand for them that they are hard to obtain in a hurry. Under favorable conditions, a 2½ cubic-yard steam shovel has excavated 2,500 to 3,000 cubic yards a day at a cost of 6 cents per cubic yard; but any novice taking a contract at any such price would undoubtedly "go broke," as there are so many unforeseen contingencies—even the material to be excavated often turns out to be very different from what was anticipated. Steam shovels are generally made to take out from ¾ of a cubic yard to 5 cubic yards (135 cubic feet) at each stroke, and a 5-yard machine should handle about 4,000 cubic yards in a 10-hour day if all goes well; but one has to be very careful in making an estimate of the work to be done by multiplying the daily capacity by the number of days in a month—for, unless the operators are all experienced men, they will be continually getting the machine off the track or even overturning it, or breaking some essential part which they may expect to replace in a day or two but for which they may then have to wait several weeks.

Some of the larger sizes weigh nearly 100 tons and can scrape up almost anything but solid rock; they are usually designed to run on a standard-gauge track, which is often hurriedly laid on more or less soft ground so that it requires much ingenuity to keep the apparatus and cars on the track, for the slightest accident or delay makes a serious difference in the contractor's output; no money is made when the shovel is not actually digging, although the expense goes on. While the majority of shovels are built to run on standard-gauge tracks, a few are constructed for very broad gauges, and still others, having very wide wheels and called traction shovels, are made to travel on the ground without any track. Still another class, which is coming more and more into use, is built something after the principle of a locomotive crane so that it can revolve completely around, through 360 degrees, and is used principally for digging cellars and handling the material in yards of manufacturing concerns.

The smaller shovels have a vertical boiler, while the larger sizes carry a horizontal boiler of the locomotive type; generally 100-pounds steam pressure is used, though occasionally this is increased to 140.



BUCYRUS STEAM SHOVELS AT WORK.

The upper one is a 65-ton shovel at the Rio Tinto mines, Huelva, Spain. The lower is a 95-ton at the plant of the Edison Portland Cement Co., Stewartsville, N. J. Built by the Bucyrus Co.

The up-to-date machines have three pairs of engines. The pair for forcing the dipper into the ground is carried on the boom itself, while the pairs for hoisting and for swinging are placed on the car which also carries the coal bin and water tank. A good 1¼ cubic-yard shovel has a hoisting engine with cylinders about 7 by 10 inches and boom and swinging-gear engines of about 5 by 6-inch cylinders, with a 4-foot diameter by 8-foot high boiler. The hoisting chain is about ⅞-inch diameter, and the total weight of the machine 24 tons. A 5 cubic-yard machine weighing about 95 tons has 14 by 16-inch cylinder hoisting engines, and boom and hoisting engines with cylinders about 9 by 9 inches each, the hoisting chain being 1½ inch.

A 1¼ cubic-yard steam shovel costs about $6,000, a 2½ cubic-yard steam shovel costs from $7,500 to $9,000, and a good shovel with a 5 cubic-yard dipper brings about $12,000. A 90-ton 4 cubic-yard dipper Bucyrus steam shovel, on a 10 by 44-foot car with 12 by 16-inch cylinder main engines and independent reversible engines for swinging gear, with a 1⅜-inch swinging cable and 1½-inch hoisting chain, the locomotive boiler being 5 feet in diameter and about 13 feet high, has handled 4,000 cubic yards per day of 10 hours. The crew usually consists of an engine driver at $140 or more a month, a cranesman at $100 or more, a fireman, and from four to six laborers.

Though steam shovels, as the name would indicate, are usually operated by steam, they have in certain cases been equipped for electrical power. The different uses to which these machines can be put are rapidly increasing, as fast as they can be manufactured. There will soon be over one hundred steam shovels in use for the Panama Canal alone—probably before this appears in print.

So far they have been used to any extent only on very heavy work, on account of the expense; but a 35-ton traction-wheel steam shovel has recently been successfully used for shallow cuts, 16 feet wide and containing only about 7,000 cubic yards, for the Hanover & York Electric Railway, by Dodge & Day of Philadelphia.

The question of cost analysis has recently been brought up in connection with the Ashokan Dam bids. It is, of course, quite true that engineers should know how to analyze the cost of their work, but they must be very careful not to be misled by such analysis. For instance, we had a contract once on which were the usual steam-shovel, engineer, crane man, and fireman, and some thirty men on the dump. There was a $5,000 a year superintendent in charge who made a good profit for his employer but left before the work was completed. His successor at $3,000, with the same plant and gang, did not turn out anything like as many cubic yards of material, turning the profit into

a loss. With the most exhaustive and careful calculations, therefore, it is necessary for the engineer to allow a very considerable percentage for doubt and unforeseen contingencies, among which might be mentioned the loss due to having the work held up by political investigation, which not only ties up the capital and plant, but also makes it necessary to do work in the winter that could have been done in the summer.

ATLANTIC STEAM SHOVEL AT WORK IN BLASTED ROCK, N. & W. RY. NEAR ROANOKE.

Built for Vaughan Construction Co. by the Atlantic Equipment Co.

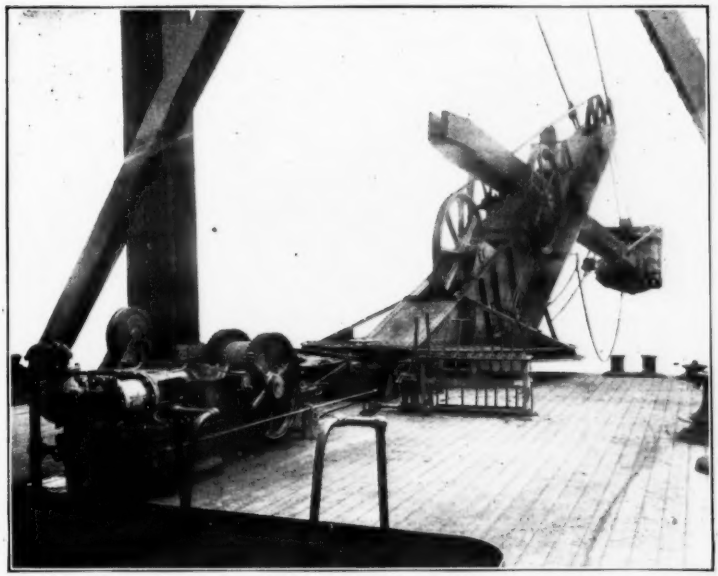
The dipper dredge does in the water what the steam shovel does on land; and indeed there are many points of similarity between the two, though the dredge is a more expensive machine and, on the other hand, capable of doing more work, the biggest one built to date having an 8-cubic yard dipper and costing complete $120,000, the boat itself being a very substantial affair. The question of "boat" has recently been the cause of a law suit to determine whether or not the operators, working in a harbor or river, should be classed as mechanics or as seamen, on Government work, the point in dispute being whether the 8-hour labor statute should apply to them or not.

The dipper dredge will rip out and lift or push aside huge boulders that the lighter and cheaper "orange peel" or "clam shell" dredges would not touch. Dredges have been designed with 10-cubic yard dippers to be operated by 18 by 24-inch cylinder hoisting engines.

While hoisting chains are still used for the smaller sizes, steel cables are much better for the bigger machines on account of being

DREDGE FOR THE CUBAN GOVERNMENT, BUILT BY THE ATLANTIC EQUIPMENT COMPANY.

The bucket is of 8 cu. yd. capacity. Hull 110 by 42 by 12 ft., spuds 40 in. square, boom 44 ft. long, all of steel. Main engines double-cylinder, 17 by 20 in. Pull upon dipper 180,000 lb.



FORWARD END AND BUCKET OF ATLANTIC EQUIPMENT COMPANY DREDGE.
Capacity of bucket 8 cu. yd.

more reliable and much quicker in action than the cumbersome chain. This can readily be understood when it is realized that the cable is now often run over a large sheave at the top of the boom direct to the drum, discarding the pulley blocks entirely.

Another dredge much used for digging gravel, sand, etc., is the chain bucket or conveyer dredge, the conveyer arrangement usually being attached to the side of the boat and readily raised or lowered as desired.

Probably the machine that can handle the greatest volume of material in the shortest time and transport it the longest distance for the least money is the suction dredge, with suction and discharge pipes all the way from 10 to 30 inches in diameter. The suction pipe is attached to a swinging arm which can be lowered to the bottom or raised up clear out of the water, like a boom; at the lower end of this arm or boom is attached a revolving cutter which will break up stiff clay or even harder material and allow it to be pumped up and discharged like so much sand and water.

The engines for operating the cutter are attached to the boat end of the swinging arm. The pumps and all the rest of the machinery are compactly placed on the boat itself, while the discharge pipes are

carried on floats to the dumping ground which may be right at hand or several thousand feet away. One can easily imagine what an immense volume of material can be pumped through a 30-inch pipe when it is realized that this has a cross-sectional area of 706 square inches, or nearly 5 square feet, and, as a rule, the pumps work very smoothly, requiring very few stoppages.

Mr. A. W. Robinson, M. Am. Soc. C. E., of Montreal, has designed some of the most powerful dredges in existence. One of them for Lake St. Peter, St. Lawrence River, has pumped 750,000 cubic yards of clay a month and deposited it 2,000 feet away. Not only this, but the original pipe line has been working continuously for five years. The same engineer also designed the dredge now working

PIPE LINE OF 30-INCH HYDRAULIC DREDGE BUILT FOR THE COMMISSIONERS OF LINCOLN PARK, CHICAGO.

Steel hull, 148 by 36 by 12½ ft. Main engines triple-expansion, 1200 i.h.p. Cutter engines double tandem compound, 300 h. p. Average capacity 1500 cu. yd. per hr.
Atlantic Equipment Co.

in Lake Michigan, making a fill for Lincoln Park, thus increasing the area by a strip 1,500 feet wide and a mile or so long, totaling up to 4,000,000 cubic yards. This dredge was built by the Atlantic Equipment Company and set to work in June, 1907. The pontoon is 148 feet long by 36 feet wide and 12½ feet deep. The suction and discharge pipes are 30 inches in diameter and are operated by 1,200 horse-power triple-expansion marine engines having two double-end marine boilers 11½ by 18 feet, with corrugated furnaces, condensing apparatus, electric lights, pumps, and auxiliaries. The cutter is 9 feet in diameter and 9 tons in weight and has eight curved steel blades which cut up the blue clay allowing it to be sucked up and discharged at the rate of 3,000 cubic feet per hour; it is, of course, operated by its own mechanism. The discharge pipe is carried on steel pontoons of 100-feet lengths, connected by ball and socket joints. This outfit cost in the neighborhood of $150,000.

LOCOMOTIVE CRANE EQUIPPED WITH ELECTRIC LIFTING MAGNET HANDLING LOOSE SCRAP.

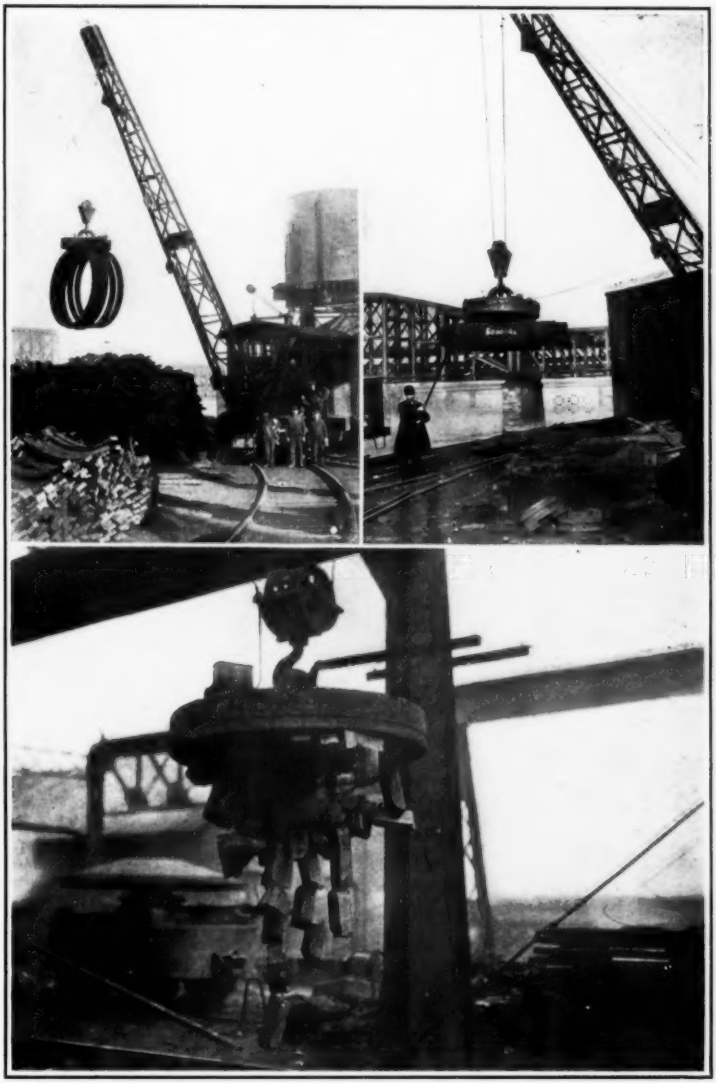
Installed by the Electric Controller & Supply Co. at the works of Moorhead Bros., Sharpsburg, Pa.

J. & J. McSpirit of New Brunswick, N. J., have handled 300 to 500 tons of rock, weighing from 6 to 7 tons, in a day of 10 hours, using a dredge with a 1½ cubic-yard orange-peel bucket; and Chas. Warren Company of Wilmington, Delaware, have handled 150 cubic

PIG MAGNET LIFTING MACHINE-CAST PIGS FROM DEEP PILE.
In the yards of the Wellman-Seaver-Morgan Co. Installed by the Electric Controller & Supply Co.

yards per hour of washed and screened sand with a derrick dredge having an A frame 40 feet high, which they built for themselves, with a 50-foot boom on a scow 32 by 87 feet, using a Lambert hoisting engine with 12½ by 16-inch double-cylinder, double-drum dredge engine, and a 2½ cubic-yard Hayward orange-peel bucket, working in 25 feet of water. The O'Rourke Construction Company, with a 3½ cubic-yard orange-peel bucket on a derrick boat has taken care of 2,000 to 2,500 cubic yards of city refuse a day.

A valuable aid in hoisting operations is the electric magnet, the properties of which have been known since 1820, although it is only recently that it has been put to commercial uses.



BROWNING LIFTING MAGNETS IN SERVICE.

Above, locomotive cranes with magnets handling in one case a 6000-lb. roll and in the other five 72-inch locomotive tires. Below, magnet on a traveling crane handling crop ends of billets. The number of pieces per lift averages 100 and the approximate weight 3500 lb. Photograph taken at Newburgh, Ohio, plant of American Steel & Wire Co. Browning Engineering Co.

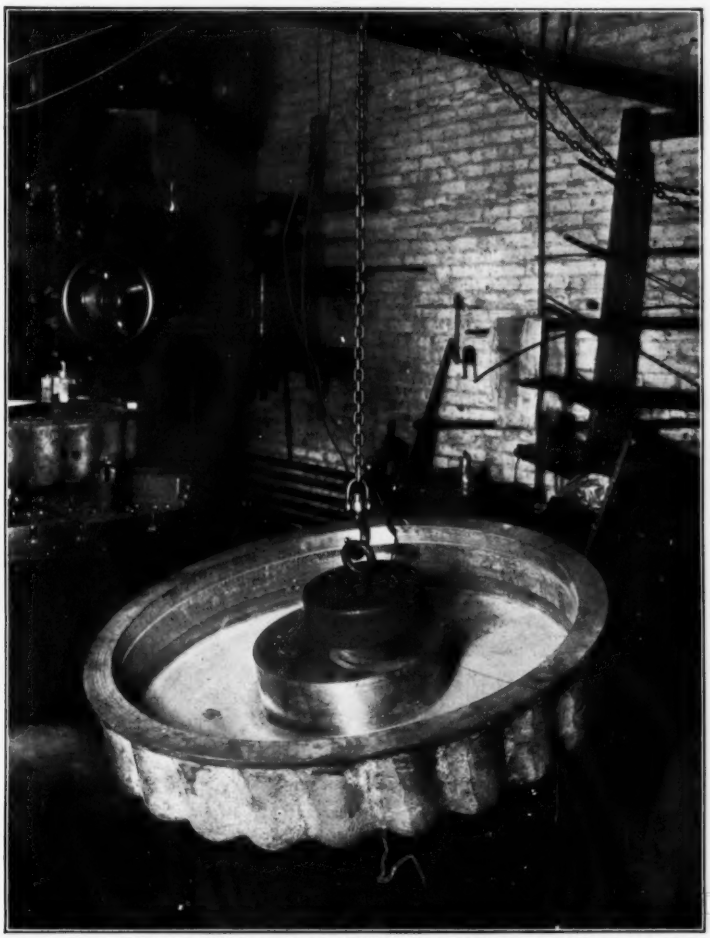
CUTLER-HAMMER LIFTING MAGNET UNLOADING CASTINGS.
Handling a winding drum weighing 3200 lb. Cutler-Hammer Mfg. Co.

It has the ability to attract iron or steel when an electric current is passed through the magnet and to release the same at once when the current is turned off. It is now used to advantage in handling iron or steel in all shapes, such as lifting scrap wire out of cars, handling steel plates, lifting safes, pig iron, etc.

In handling plates a skilled operator can lower his electro-magnet onto a pile of plates and lift up half a dozen or so; then, by turning his switch for an instant, he can drop the bottom plate and turn the current on again in time to prevent the rest of the plates from falling.

It is not difficult to comprehend what a labor and time-saving device this is, doing away with all hooks or grapples and men to adjust them, especially where they would have to pry up the plates or other pieces to get the hooks or chains under.

While the principle has been known these many years, the details of the practical lifter have required much recent study and experi-



A 10-INCH CUTLER-HAMMER MAGNET LIFTING THE BODY OF A 50-INCH MAGNET.

The casting, ready for insertion of the coil and coil shield, weighs about 3000 lb. and is of awkward shape to handle with slings. An apt illustration of the advantages of this mode of handling castings is thus afforded. Cutler-Hammer Mfg. Co.

ment, as the magnets have to be adapted for each kind of work; for instance, one that will readily lift a 10,000-pound ingot will not lift a long thin piece weighing only 1,000 pounds, or even a single piece of pig iron weighing only 100 pounds from a pile of pig. The design of a magnet to lift from 20 to 25 pieces of pig at a time without having the current scattered all over the pile, gave a vast amount of trouble before success was reached. Mr. S. Piek has designed a magnet weighing 5,000 pounds, which uses 27 amperes at 220 volts in lifting about 25 pieces of pig iron from an indiscriminate pile, even causing the pig to jump vertically from 4 to 6 inches to attach itself.

Mr. S. T. Wellman, a pioneer open-hearth steel man, was one of the first to foresee the advantage and undertake the design which was afterwards advanced by Mr. Eugene B. Clark of the Illinois Steel Company and then by the Electric Controller and Supply Company of Cleveland, some of whose machines have been built for the Imperial shipyards of Yokohama, Japan. A magnet to stand the hammering due to lifting and dropping say 800 tons of pig iron a day requires considerable more study than is required merely for the magnetic circuit.

The United States Government realizes the advantages of up-to-date machines in handling mail through pneumatic chutes, etc., but the New York City government is still far behind the times in getting rid of street sweepings, snow, and like material. If the streets were kept in the condition in which Col. Waring showed they could be kept, or as they are kept in Paris, perhaps automatic street sweepers would not be needed, unless for removing snow. Would it not be possible to have one that would sweep the snow up, melt it, and turn the water into the nearest sewer?

The Standard Oil Company has shown the advantages of transporting oil under rivers across country, through pipe lines.

One naturally associates with the idea of hoisting machines the process of handling heavy objects; but we have witnessed the introduction in New York and elsewhere, so quickly and effectively as to be scarcely noticed, of an elaborate system to carry objects of almost no weight, comparatively, but with an enormous saving of time; and that is the system of handling cash in our big stores and replacing the "cash boys" and "cash girls," by the so-called "telpherage" cableways. Worked by electricity, they have also been designed to carry all sorts of loads and all sorts of speeds, running from 60 to 120 feet per minute for the hoist and from 600 to 1,000 feet for conveying.

Floating cranes are very important implements and are very much more elaborate than an ordinary derrick boat, which is allowed to tilt

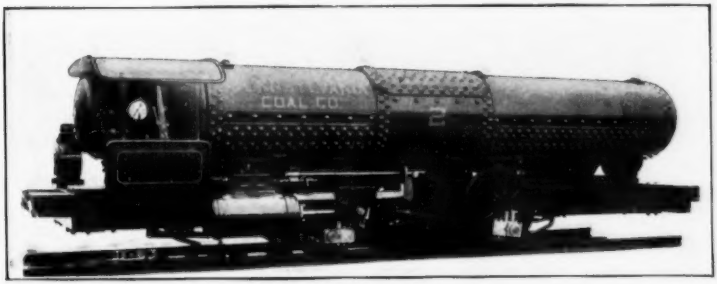
more or less under its load, while the 100-ton floating cantilever crane built for the United States, on a steel pontoon 60 by 100 by 11 feet deep, for example, carries in addition to the usual water ballast an automatic counterweight weighing 250 tons, which travels in such a way that the keel is always kept level or horizontal, so that when the heavy turrets of a ship are handled there is not only no swaying of the boat; but it is even held so steady that an exact adjustment can be made to 1/16 of an inch, and any load not over 40 feet wide nor weighing more than 100 tons can be carried from one end of the cantilever to the other, passing between the rigid legs on the pontoon supporting the cantilever or placed on the pontoon itself. When these details, which make the floating crane almost as stable as a land derrick, are considered it will be understood why a crane like this one can cost as much as $225,000.

The locomotive, one of the most economical tools for handling material, has not been described here as its uses are more generally known than other kinds of machines. When the Manhattan Elevated introduced the third rail, they sold off nearly all the old locomotives to contractors and others, some going to Japan and in fact pretty nearly all over the world. The traction locomotive pulling a big load of logs in New York State (page 207) is probably not so familiar, nor is the use of the compressed-air engine so well known. While the compressed-air engine can be used in many

A DITCHING EXCAVATOR IN OPERATION
The Municipal Engineering & Contracting Co.

ONE OF EIGHT UNLOADERS FURNISHED THE PANAMA RAILROAD CO. FOR USE AT LA BOCA.

The tidal variation is about 20 ft. The 80-ft. boom, in its working position as shown, will carry loads over a vessel's deck at high tide while the inner end is within the warehouse door. Main tower 62 ft. above track, with clear portal 10 ft. wide. Gantry base 11 ft. gauge, 6 ft. high in the clear. Speed of hoist and of racking each 150 ft. per minute. Hoist operated by 65 h. p. rack motion by 40 h. p., travel by 24 h. p. and boom hoist by 8 h. p. motor. All motions controlled by one operator. Shaw Electric Crane Co., Muskegon, Mich.

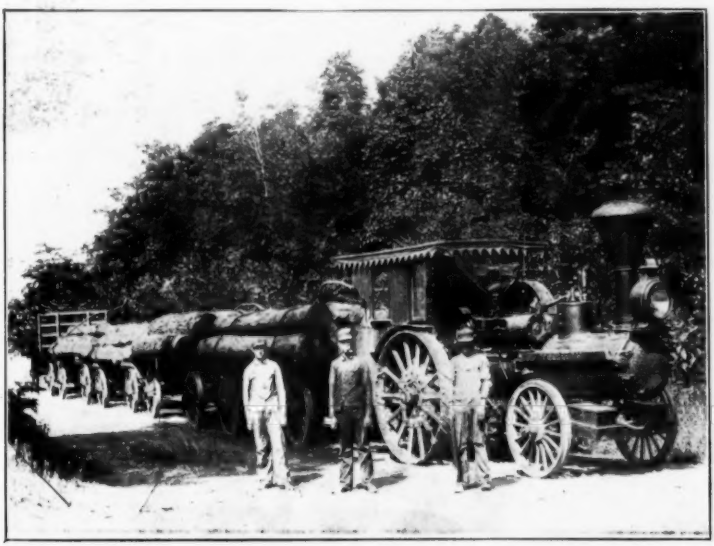


A COMPRESSED-AIR LOCOMOTIVE.

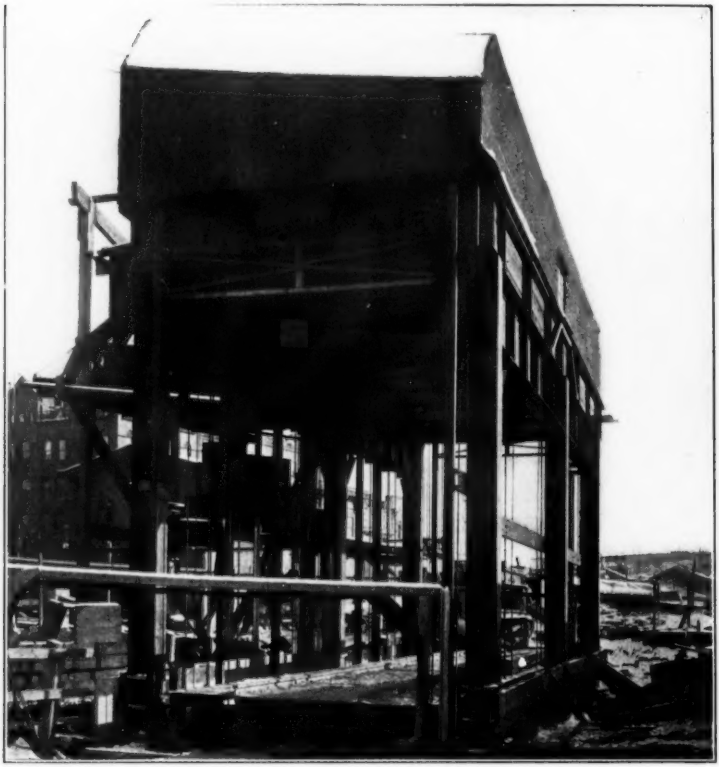
Gauge 3 ft., storage pressure 850 lb., working pressure 130 lb. Weight 22,100 lb.; tractive power (max.) 4797 lb. American Locomotive Co.

places to compete with steam and electricity, it has a decided advantage over the others wherever there is any danger of fire, such as in dangerous coal mines, powder mills, cotton mills, or wherever explosive or especialy inflammable materials are manufactured.

Instead of an ordinary locomotive boiler these engines have one or more storage tanks filled with air at a high pressure. It is stated that the plant required costs about the same as an electrical plant, but that the cost of operation is less for the compressed-air engines. These engines cost from $2,500 to $3,000.



TRACTION ENGINE HAULING A LOAD OF LOGS, SWARTWOOD, N. Y.



SPECIAL ELEVATOR EQUIPMENT FOR ELECTRIC PASSENGER CARS, HUDSON & MANHATTAN RAILWAY.

Platform 50 by 12 ft., lifting capacity 100,000 lb. Operated by 100 h. p. motor, driving two 50 ft. drum shafts through balanced worm gears. Controlled by pilot switch operated by hand shipping cable. Speed 10 to 20 ft. per minute; lift 30 ft.
Geo. T. McLauthlin Co.

Undoubtedly one of the best places to study hoisting machines is at some place like Lorain, Ohio, where the ore is taken out of the lake boats, one machine taking what it can handle best; then the boat is moved on to another machine and perhaps again—for at these places it is fully realized that different kinds of tools are required for different purposes; so we see a great many different kinds of machines at work side by side, each doing that for which it is most fitted.

This lesson should also be learned, but very often is not, by those who have to design rigid structures of steel, stone, concrete or concrete-steel, all of which have their proper places, but none of which should be used indiscriminately at all times and in all places.

THE NEW MUSEUM OF SAFETY DEVICES AT PARIS.

By Jacques Boyer.

M. Boyer's description of the leading museum of safety devices in France possesses a particularly timely interest in that it appears while the second exhibition of a similar kind in America, held under the auspices of the American Museum of Safety Devices, is still in progress in New York. In European countries such museums and exhibitions have had a most potent influence in advancing the cause of industrial betterment and we are glad to be able so opportunely to second the efforts of the American workers in this field by the publication of so interesting and comprehensive a review of the latest of the great European institutions.—THE EDITORS.

THE new museum of safety devices for preventing accidents and promoting industrial hygiene, installed in December, 1905, at the Conservatoire des Arts at Métiers de Paris, is more a permanent exposition than a museum. As the art progresses, more highly perfected devices replace the older inventions which are relegated to the rank of curiosities in the historical collections of the same establishment.

Today, when powerful and complicated mechanism is substituted almost everywhere for the primitive tools of former times, the prevention of accidents becomes a veritable science. Numerous societies have been founded to draft laws and to study the economic and social consequences, so as to assure, as completely as possible, the safety and the cleanliness of factories now in operation throughout the world.*

The first organization of this kind was founded by a great captain of industry (Engel Dolfus, of Mulhouse) in 1867, and since that time innumerable similar societies have sprung up. There exist also museums similar to the one which is the subject of this article. Among the principal of these may be cited that at Vienna (1890), at Amsterdam (1891), at Berlin (Charlottenburg, 1903). This last one has cost about one-million marks and possesses an annual budget of forty-thousand marks.

The new Parisian museum was founded by the "Association des industriels de France contre les accidents du travail," established in 1883 by Emil Muller, and was organized entirely by private gifts.

* For a study of certain aspects of this question as developed in France, the reader is referred to an article by M. Bover which appeared in THE ENGINEERING MAGAZINE in December, 1902, page 418.

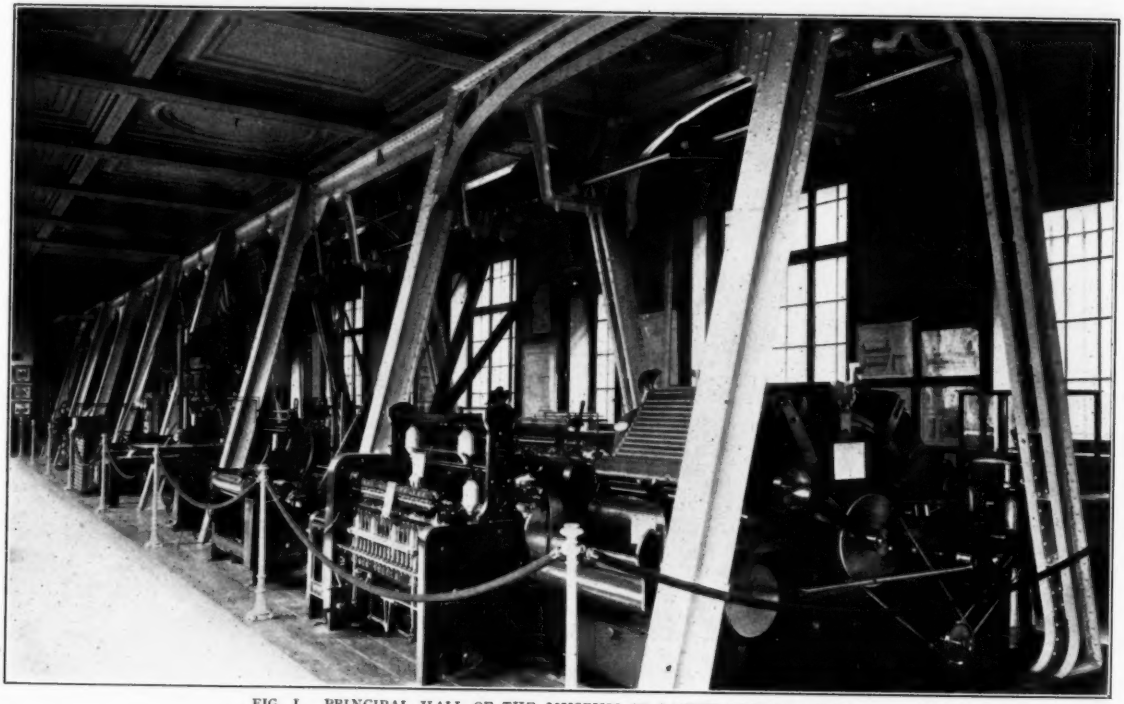


FIG. I. PRINCIPAL HALL OF THE MUSEUM OF SAFETY DEVICES, PARIS.

It had as its nucleus a unique collection of models and protective devices, brought together by the said association, the principal promoters of which were MM. Buquet, Cheysson, G. Dumont, Liébaut and Périssé. Its purpose, inspired by philanthropy, is to indicate to the present patrons the precautions to be taken, the devices and the means to employ, for protecting their workmen against risks of all sorts—unhealthful atmosphere; dangers from machines and transmission devices, harmful dusts, high electric voltages, poisoning, etc.

To start with, the new museum consists at present of three halls. In the main hall, of which Figure 1 shows a general view, a series of diverse machines are grouped, their protective devices being painted in red so as to stand out by contrast. The first machine in the picture is a carding-machine, exhibited by the "Société alsacienne de construction mécanique." This machine, which is of great importance in the spinning industry, removes some of the impurities from the cotton and begins the arrangement of the fibers in parallel directions. In this model the flats travel in a direction which is the reverse of that usually employed in machines of this kind. The cotton, which is carded by the flats, just before leaving the working surface encounters a flat which is perfectly clean and more apt, therefore, to remove the small impurities which are still there. The flats traveling in the opposite direction to that of the cotton become loaded little by little. The largest impurities are removed at the moment when the flats quit the working surface and are ready to be cleaned, therefore there is no danger that the impurities once removed will again become entangled in the cotton. The flats are regulated from a single point.

From the point of view of the prevention of accidents, the card of the "Société alsacienne" is furnished with wheel and gear covers for every part with which the workman who has charge of the machine could possibly come in contact. The parts protected are the following: the wheels driving the feeder cylinder, the comb, the flats, the brush, and the doffer.

A spinning machine is situated at the side of the carding-machine. It transforms the cotton coming from the roving-machines into yarn ready to be utilized in the further spinning operations; that is, weaving, thread making, etc. The bobbins are placed on a rack; the roving of cotton is unwound and passes through a series of drawing rolls which give it the desired fineness. Then the yarn is twisted by a flyer fastened to the extremity of the spindle or by a traveler on a ring, and is then wound on the spindle. The spindle is driven by cords passing over iron drums driven directly from the transmission.

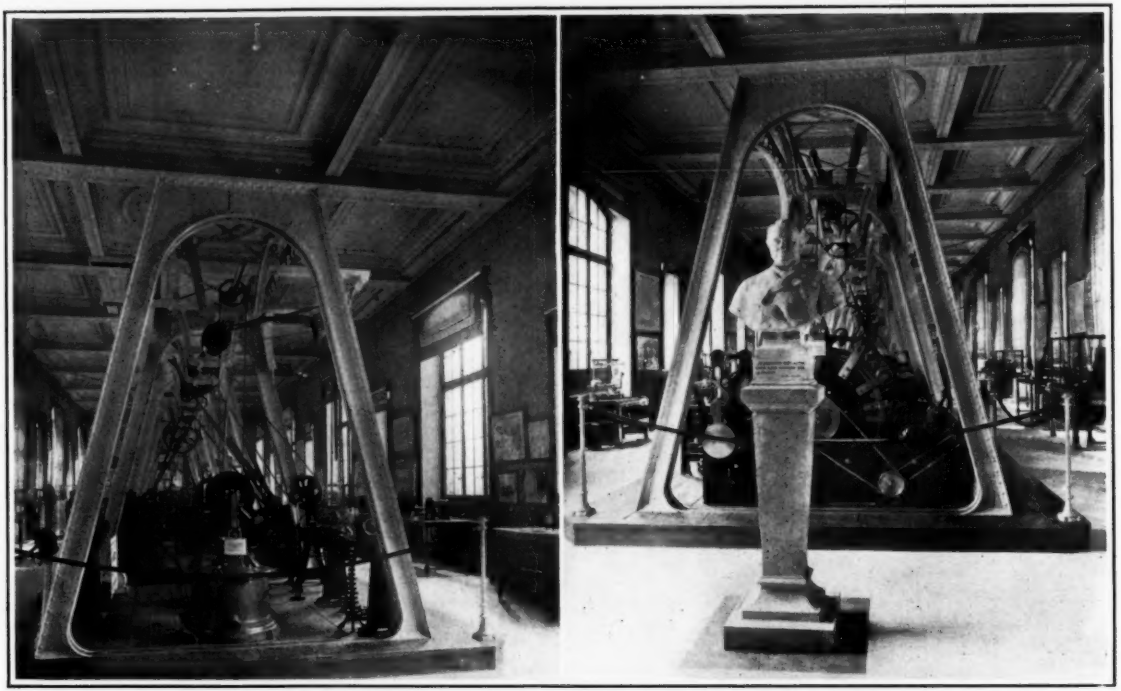


FIG. 1 A. TWO VIEWS OF THE MAIN HALL, TAKEN FROM OPPOSITE ENDS.

By courtesy of Dr. W. H. Tolman, Director of the American Museum of Safety Devices and Industrial Hygiene, New York.

A series of toothed gears transmit the motion to the drawing rolls. These wheels are placed on one side of the frame, and are the most dangerous parts of the machine. In this machine they are covered with cast-iron plates, and can be rendered accessible only by the removal of these plates. The wheels which transmit the motion from one drawing cylinder to another are also equipped with gear covers.

Passing rapidly to the roving-machine, which is equipped with a safety stop to the Blin protector for shears, and the Northrop loom which is located in the same hall, let us note the ingenious shuttle-guard of Koch-Hurst (Figures 2 and 3), which consists of a bar made of half-round steel and suitably supported. This bar is riveted to two pieces which are supported by two rectangular shaped malleable-iron devices screwed to the head of the lathe. Powerful springs press on the piece which supports the rod and holds it in the position shown in Figures 2 and 3. When the shuttle leaves the box this bar holds it in front. A small wooden dog in the form of a triangle fastened at the extremity of the apparatus and below the lathe head, obliges it to descend and re-enter the shuttle-box. The workman in placing his hand on the head of the lathe exercises a slight pressure with his thumb on the bar which drops down under the lathe head and completely exposes the reed. It remains in this position as long as the loom is stopped, but as soon as it starts up again the shuttle-guard goes back automatically to its former position and remains there during the operation of the loom.

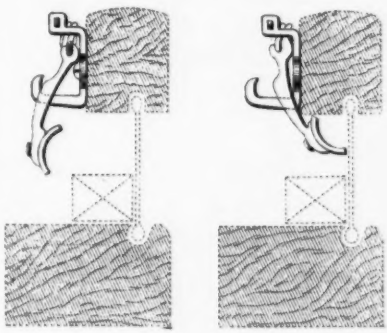


FIG. 2-3. KOCH-HURST SHUTTLE GUARD, WITH THE LOOM STOPPED AND THE REED EXPOSED, AND WITH THE LOOM IN OPERATION.

Protectors for circular saws, planers, and other wood-working machines are to be found in the museum, as are also various systems of couplings for pulleys or gears; but these devices are so well-known that they will not be described here; neither can we undertake to describe the centrifugal dryers and cream separators. Suffice it to mention the novel protector for emery wheels, exhibited by "Fabriques réunies d'emeri" of Paris. The great strength of this elastic and adjustable protector (Figure 4) is due to the fact that

it is built up of several layers of sheet steel, each having a thickness of from 1 to 1.5 millimetres, increasing with the number of thicknesses used. The elasticity of this protector is considerably greater for a large number of layers than for a single layer, and especially in the large sizes is far superior to the ordinary guards which consist of one piece. It is well-known that blows and shocks applied to an elastic body do not produce any noticeable effect, while the same forces acting on a rigid body would cause it to fly to pieces at the end of a short time. Because of this elastic characteristic, the effect due to the bursting of an emery wheel is quickly overcome and rendered harmless. The easy adjustment of this protector is due partly to the sheets of steel considered separately, and partly to the elasticity, which remains constant when several sheets are superposed, one upon the other.

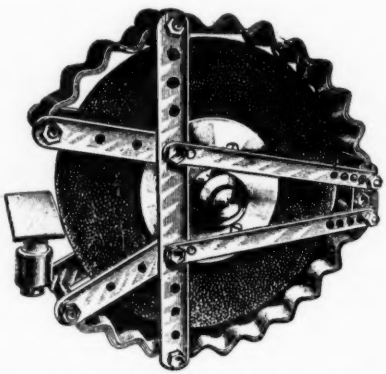


FIG. 4. ELASTIC ADJUSTABLE PROTECTOR FOR GRIND STONES.

In the main hall there are also portable belt shifters for running belts off and onto pulleys, vacuum cleaners (Chapal system) and various protective devices for printing machines. These latter include: a metal plate covering the spokes of the fly-wheel; a disk fastened to the fly-wheel and covering the head of the key; a copper plate covering the teeth of the large gear; a guard for the gearing of the fly-delivery; a corner iron covering the rack of the ink bed, and a guard for the interior wheel driving the gearing (Figure 5).

The most interesting corner of this same hall of the museum contains a show case where are exhibited, by Dr. Detourbe, on plaster-cast heads, different types of goggles and respirators for protection against dust (Figure 6). There are goggles to be used by railway operators, automobilists, etc., and goggles for use in shops to protect the eyes from explosions, flying particles, dust and light. They are in the form of two irregular truncated cones, the large base being moulded, so to speak, to fit the corresponding parts of the head, and the small base being arranged to carry the glasses. The cavity formed between the eye and the goggles is ventilated by a large number of perforations in the walls, the function of this ventilation being to

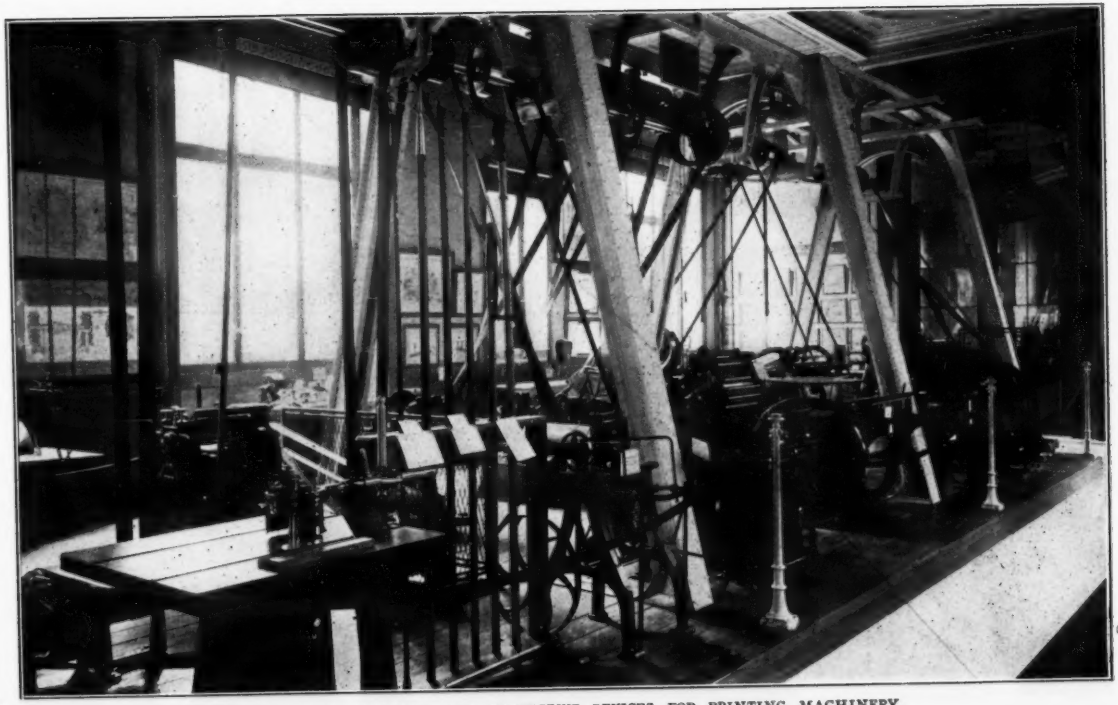


FIG. 5. BELT SHIFTERS AND PROTECTIVE DEVICES FOR PRINTING MACHINERY.

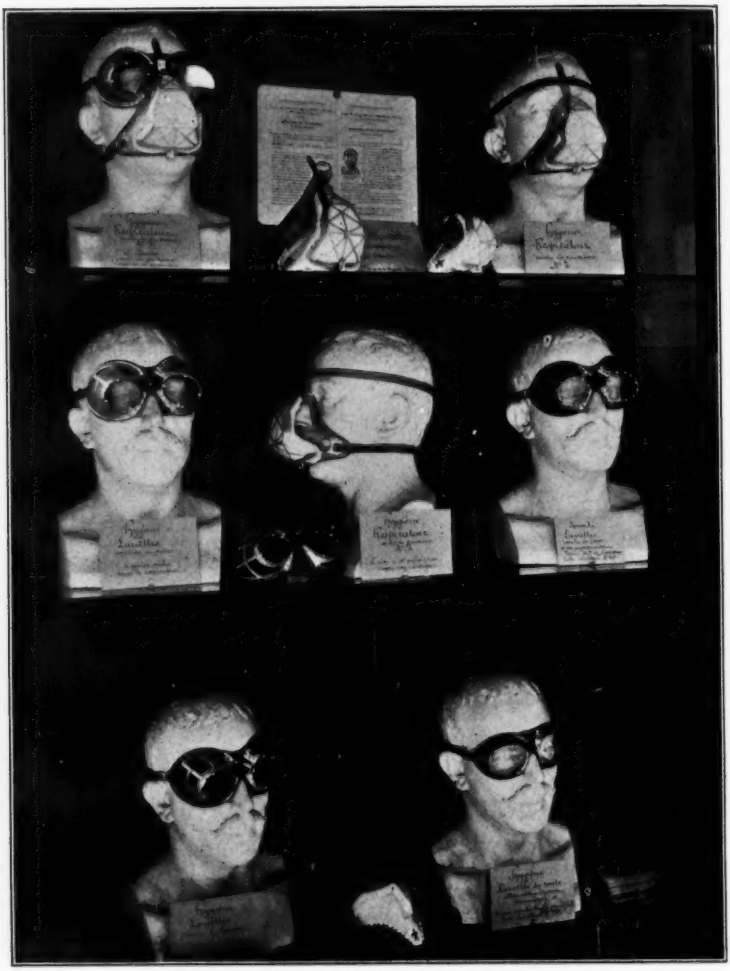


FIG. 6. PROTECTIVE SPECTACLES AND RESPIRATORY APPLIANCES FOR PROTECTION AGAINST DUST, DEVISED BY DR. DÉTOURBE.

protect the eyes from heating, and the glasses from becoming blurred with steam. The two parts are joined by a flexible nose piece which renders the device perfectly adaptable to any shaped face.

Against excessive light, Dr. Detourbe recommends the neutral smoked glasses (showing the natural color of objects). For use on the road, he recommends glasses with a considerable curvature giving

an extended field of vision (140 degrees); the glass may be plain or smoked. The space between the face and the glasses is closed in by one of the following methods: strong metallic fabric (goggles for protection against explosions and flying particles); gray linen cloth (goggles for protection against dust); black cloth (goggles for protection against light).

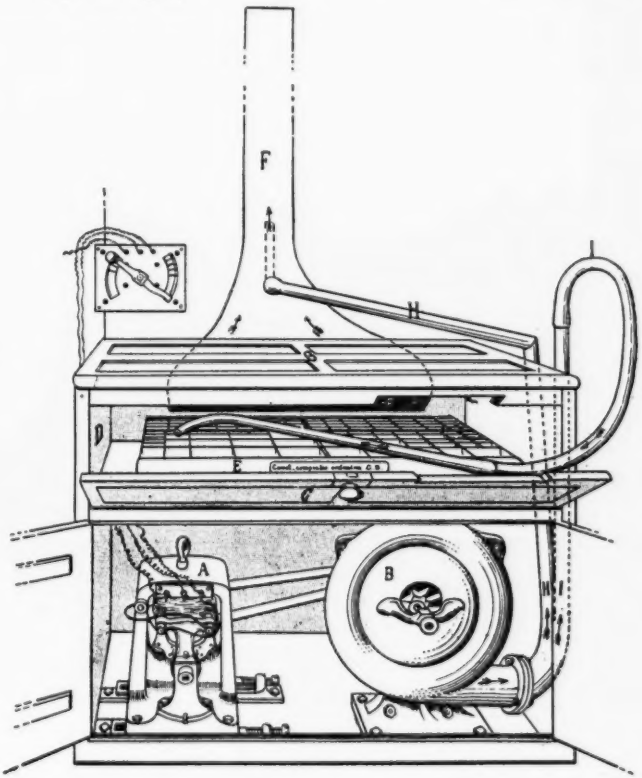


FIG. 7. DELMAS TYPE BLOWER.

The respirator of the same inventor has the form of a truncated pyramid opened at the summit on its lower face and on its upper edge. The opening for respiration and filtration of air is very large. About 5 millimetres in front of this opening is placed a hinged flap, both the opening and the flap being covered by a screen; the space between is filled with a layer of non-absorbent cotton which assures perfect filtration of the air breathed in, and the absolute interception of

dust. The base surrounds the nose and the mouth, and is made up of three curves corresponding to the contour of the face on which it is, so to speak, moulded. The air chamber between the nose and the mouth and the filter prevents the heating of the face. It is lined with a woolen stuff impregnated with rubber which does not collect condensation nor become soiled with use. The absence of valves avoids the rapid obstruction of the cotton by dust breathed in. The air breathed out through the cotton presses the dust back toward the outside and cleans the filter. According to the reports of several experts, these breathing devices, which have been constructed of aluminum, or nickel-plated brass, assure a perfect protection and do not in any way inconvenience the workman.

FIG. 8. RESPIRATORY HELMET, PARIS FIRE-DEPARTMENT TYPE, AND PROTECTIVE HELMET FOR SAND-BLASTERS, CASASSA SYSTEM.

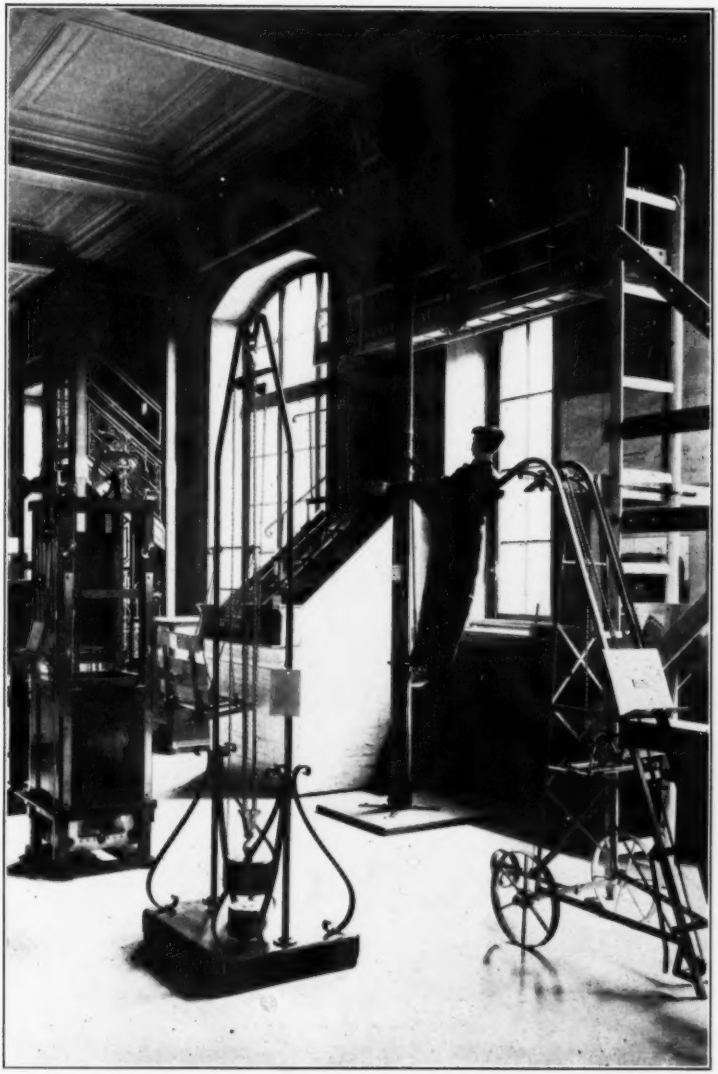


FIG. 9. CHEVENIER SAFETY HOISTS, NUGUE CLIMBING LADDERS, AND SAFETY BELTS FOR ELECTRICIANS, ETC.

FIG. 9 A. GENERAL VIEW OF THE HALL CONTAINING SAFETY HOISTING AND CLIMBING DEVICES, ELECTRIC PROTECTIVE APPARATUS, ETC.
By courtesy of Dr. W. H. Tolman, Director of the American Museum of Safety Devices and Industrial Hygiene.

While speaking of dust, we may describe the type blower of Delmas (Figure 7), the purpose of which is to clean printers' cases in a closed compartment D into which the case E is slid. The ventilating duct F is then closed. A pipe from the blower is placed in the ventilating duct at the right, and the blower started. The dust is then removed to the box and escapes by the hole F, which leads to the ventilating duct F′ which carries the dust to the exterior by suction. In the illustration herewith, the electric motor A drives the ventilator, however, it may be driven by a belt, or a foot pedal. A current of air B forced into the duct F′ produces a suction which removes the dust from the glass compartment. The use of the type blower removes the dust from the cases, thus preventing diseases which result from its absorption.

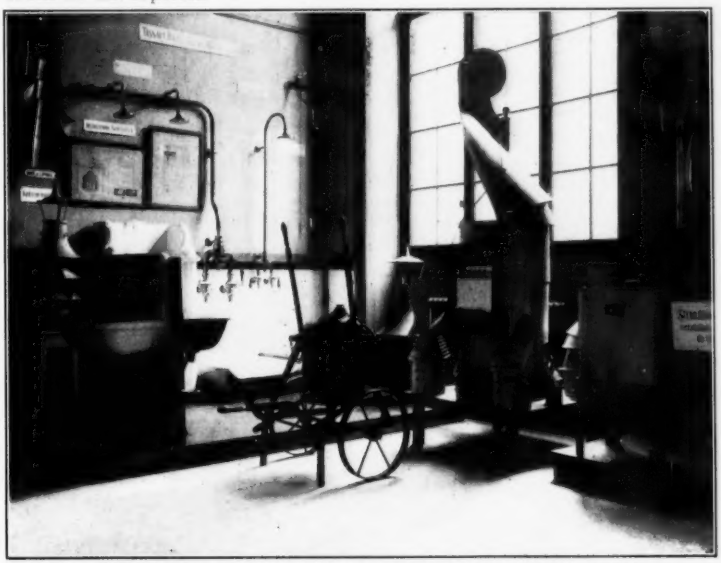


FIG. 10. SWING TOP FOR CHIMNEYS, AND SANITARY INSTALLATIONS.

Along the same line are the breathing helmet, and the helmet for sand-blasters (Figure 8), exhibited by Messrs. Casassa Sons.

In the hall situated at the other end of the museum we find a great assortment of hoisting devices, hoisting blocks, movable ladders, climbing harness for linemen, safety devices for roofers, various models of elevators and protective stair cagings (Figure 9). A little farther on, we meet with rocking devices for emptying carboys, chimney swing tops of the Laferte system for removing smoke, steam

and bad odors; numerous washbowls, shower baths, and other sanitary installations (Figure 10).

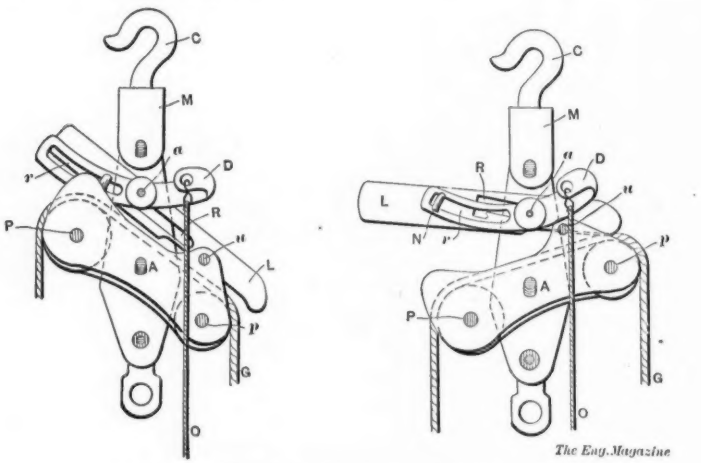


FIG. 11-12. DETAILS OF CHEVENIER HOISTING TACKLE.

A, axis of the block; *a*, axis of release lever; D, release lever; G, hoisting chain; L, clutch lever; O, operating cord of release lever; P, pulley; *p*, roller.

Since it is impossible to describe everything, we will restrict ourselves to some of the most ingenious mechanisms. We will take up first the hoisting block of Chevenier, which stops automatically and which is equipped with a safety release. It is made in ten sizes, for hoisting weights from 50 to 3,000 kilogrammes. The upper block differs from the usual form, in that the pulley over which the chain passes is replaced by a peculiarly shaped block swinging about the axis A (Figure 11). This block carries at one extremity a pulley P, and at the other a roller *p*, over which passes the chain G. A lever L which can be pressed against the roller *p*, grips the chain and thus stops the motion. If one pulls on the chain, the oscillating block tips forward, the lever L releases and allows the chain to move. If the pull on the chain ceases, the block tips back again (Figure 12) and the lever grips the chain with a force the magnitude of which is greater the greater the weight of the load. The lever and the roller having neither grooves nor projections, cannot wear out the chain. Lowering is as simple as hoisting. The clutch lever slides on a pin *a* which serves as an axle for the release lever D. The release lever can only operate when the oscillating block is tipped forward (Figure 11) by the pull on the chain. At this moment, by pulling the small cord O, which is fastened at the extremity of the release lever, the

clutch lever is caused to butt against the pin *a*, and prevents the block from swinging backwards. The chain passes freely, and one has simply to let the chain run when lowering the load. To stop quickly, a pull must be exerted on the hoisting chain, which will allow the clutch lever to fall and stop the descent. It is absolutely impossible to lower the load without releasing, and this release can be made while holding the load only by pulling on the hoisting chain. Full load can be stopped when lowering, without shock and with the slightest pull on the hoisting chain.

The climbing harness of Ravasse-Luilier (Figure 13) is intended to prevent falls of linemen, carpenters, roofers, painters, ironworkers, etc. It consists of a broad, strong leather belt A, which the workman fastens around his waist, and a protective device consisting of a leather strap D, on which slides a double ring E. The further end of this strap is provided with a movable snap C, which can be hooked on one of the rings B. The running knot formed about the pole or the tree by the strap, and the ring, prevents the climber from falling. The protection is automatic, rigorous and instantaneous.

FIG. 13. RAVASSE-LUILIER SAFETY BELT.

The "Société du verre étiré" exhibits some water gauges fitted with automatic valves, and various water-level alarms. The former (Figure 14) resemble the ordinary water gauges. In the lower gauge cock the drain cock carries the small ball which rests in a hollow in the top of the passage. In the upper part of the gauge cock, the passages form a cross which allows a free circulation of water in the glass, and exhausts the steam and water when it is desired to clean the glass. In the passage which connects with the glass, there is reserved a slight hollow in which the ball will place itself whenever the tube explodes, and will stop all loss of water. The upper gauge cock is provided with an air chamber which maintains the ball at rest when the gauge is in proper operation. In front of the ball there is placed a plug provided with passages which allow the steam to pass freely into the glass. However, in case the glass should break, the sudden overbalancing of the pressure would force the ball into the hollow of this plug and effectively prevent the escape of steam.

The gauge protectors, types A and B, the first of which is shown in Figure 15, are designed to protect persons from broken glass, steam and boiling water, in case of explosions and at the same time not interfere with the reading of the glass. The type A consists of a

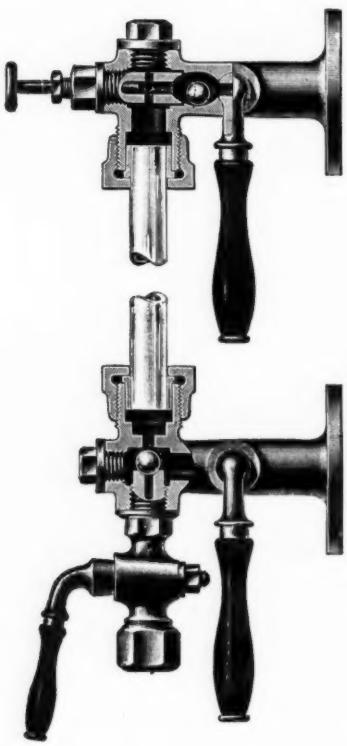


FIG. 14. WATER GAUGE WITH AUTOMATIC SAFETY VALVES.

sheet-steel shield, elliptic in form and enameled, preferably white, with grooves on the edges, in which is placed a protective glass which may be reinforced with wire. At each end of the protector there is fastened a hexagonal collar, which is clamped to the nut at the extremity of the gauge glass. These collars are supported so as to permit easy and positive longitudinal adjustment. In the back of the shell there is a scale made up of squares arranged to form a broken line, which facilitates the reading of the water level. The line of squares observed through the water glass retains its normal appearance in the part visible above the water level, while that which is seen through the water mass appears to be made up of regular horizontal stripes extending entirely across the water glass. If the protective apparatus is used with a non-reinforced glass, the water glass should be enclosed in a coil of steel wire 0.6 millimetres in diameter. It will not interfere in the least with the reading of the level, and in case of explosion of the tube will prevent flying particles from breaking the outside glass. The type B protector is of the same construction as the type A, except that the interior is painted entirely white, the scale which is colored and transparent being on the outside wall of the water glass. The interior of the apparatus being enameled white will reflect light on the water glass, and will show up very clearly the water contained in the glass. The narrow colored scale placed on the back of the water glass will impart a tint to the entire mass of water, while above the water in the empty part of the glass, the scale will appear as a narrow strip.

Finally, in the small intermediate hall of the museum there are

found, among other things, six show-cases in which the "Association parisienne des propriétaires d'appareils a vapeur" have brought together a large number of specimens of defective parts of steam boilers illustrating interior corrosion, exterior corrosion, scales, pockets formed by overheating, various kinds of cracks in the shell and in the rivet seams, incrustations, damaged fire tubes and water tubes, etc. This collection is of great interest to practical operators. This is not the first service that the above mentioned society has rendered to the French engineers; their purpose is to prevent accidents and explosions of boilers, and to teach economy in the production and use of steam.

Their means of action consists in maintaining a bureau of inspectors who inspect boilers and auxiliary apparatus; in maintaining a bureau of steam experts who give theoretical and practical advice; in organizing special courses, and otherwise propagating the proper instruction of firemen and steamfitters. They guarantee to members two inspections per year per boiler. One of these inspections, called an internal inspection, which is of capital importance, is made when the boiler is shut down, and after a complete cleaning, the object being to discover faults in the sheets and rivet seams, and in general, all faults which cannot be detected while the boiler is in operation, and which if unnoticed could lead to serious accidents.

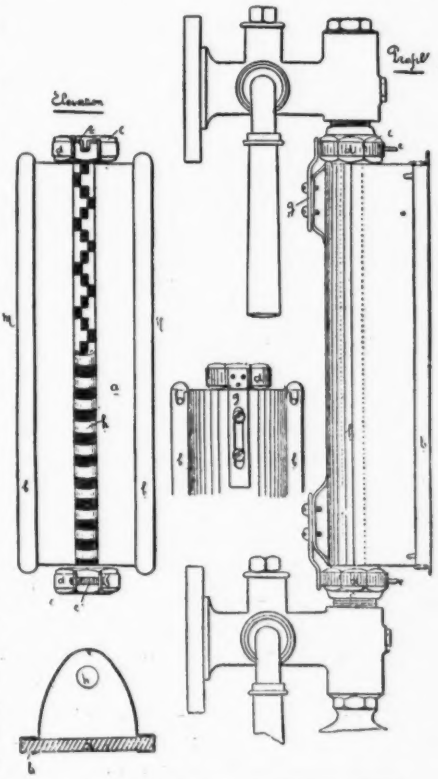


FIG. 15. WATER-GAUGE PROTECTIVE DEVICES.

a, protective glass; *b*, metal shield; *c*, gland; *d*, hexagonal collar; *e*, first mode of attachment; *é*, second mode; *g*, fastening of the protective shield; *h*, water glass.

The other inspection, called the exterior inspection, is made during operation, the object being to test the safety devices, such as gauge glasses, pressure gauges, safety valves, etc.

While the most fastidious precaution, the most vigilant attention, and the most perfect industrial hygiene all act to reduce to a minimum the number and seriousness of accidents, they cannot pretend completely to suppress them, since by definition the accident is the unforeseen. It often happens that in spite of the most perfect care, the injured one, even after the most irreproachable organic reparation, requires a complementary, functional reparation; otherwise, what appears to be a temporary disablement may render him a permanent invalid. These results of accidents which survive the medical or surgical treatment, consist most often in stiffness, leading more or less rapidly to ankylosis, in muscular retraction of tendons and aponeurosis, cicatricial adherences, atrophies, paralyses, deformities, deviations, etc., which according to their duration and their location add to the injury an aggravation often more considerable and always more annoying than the original injury itself. It is the reparation of these functional derangements following accidents, to which has been consecrated one of the most happy applications of mechanical therapy. Mechanical therapy may be described in principle as follows:

1. Exact and precise localization of the exercise or movement of a single organ which needs it to the exclusion of all others.

2. Mathematical dosage of the movement.

Mechanical therapy may be summed up as the localization and dosage of movement by means of an infinite variety of mechanical devices of extreme precision, driven by a motive power external to the patient (passive movement), or by the patient himself (active movement). The "Institut de mécanothérapie de Paris" exhibits a series of devices intended to demonstrate that this method (adopted long ago in other countries, but still new in France) can often heal the injured. The hospital cures the wound, or reduces the fracture, while mechanical therapy adds to the organic cure the functional cure.

Unfortunately we have not space to describe these devices which were invented by the members of the "Institut mécanothérapique de Paris" to achieve these results and which reveal much more of the art of medicine than of the art of the engineer.

In closing this visit to the museum, we may mention the following articles which are exhibited in the same hall: stretchers; boxes containing first aid to the injured; safety lamps for miners; shin protectors; aprons, and breeches for founders.

MAXIMUM PRODUCTION THROUGH ORGANIZATION AND SUPERVISION.

By C. E. Knoeppel.

II. SYSTEMATIC PROCESSING, MACHINING, ASSEMBLY, AND ERECTION.

Mr. Knoeppel's preceding article, published last month, introduced this series with a discussion of the adjustment of internal organization in the factory so that the utmost working efficiency may be secured. Succeeding papers will take up economy in the use of material and time, and the methods which secure better deliveries and more satisfied customers.—THE EDITORS.

A MAN once told me that a manufacturer who was not conducting his affairs in a manner to insure maximum results had absolutely no right to be in business; that he should step down and out and give way to someone who would fully appreciate the possibilities and take every advantage of them—who would leave no stone unturned until a full measure of success was his.

Such a statement might on first thought seem rather startling; in fact, it impressed me to such an extent that I asked a number of manufacturers how they felt toward those who were conducting their business in an unsystematic manner. One replied by saying that he had just been advised that his bid on a large contract had been rejected because of a much lower bid on the part of some other concern; that he was in a position to know that the work could not be made at a profit by his competitor at the price he quoted. He said that he knew how much labor and material the work would take, and as his burden rate was accurate, he knew that his bid was actual cost plus a reasonable margin of profit; but that his competitor got the work and would lose money while he lost the work and an opportunity to make a profit.

Another stated that he had spent considerable time and money in an effort to organize and systematize his business so as to enable him to secure maximum results; that he knew where his losses ceased and his profits began, as well as just what he would have to accomplish in the way of a production; and that he was willing to give to any of his competitors the benefit of this expenditure of time and money, if it would result in a more intelligent competition. While he realized that his competitor who conducts his business in a careless manner is

destined either to be forced to put his house in order or go out of business, the fact remained that his business as well as the business of many others was far from being benefited by a competition that could lay absolutely no claim to intelligence.

It is not the purpose of this article to go into a detailed discussion regarding the rights and privileges of a manufacturer, and while it is a fact that he may conduct his business in any old way that he may elect, there being no law against his so doing, there should be some means to prevent him from involving others in the harm that he is bringing upon himself. Should a bank get into financial difficulties, measures are promptly taken not only to look after its affairs but to prevent other banks from becoming involved; but what protection has a manufacturer from those whose "penny-wise, pound-foolish" policies cannot fail to have a detrimental effect upon the whole business structure?

A manufacturer should certainly have no right to stand in his own way or "fool himself" if by so doing he in any way jeopardizes the success of another. Many of the readers of this article no doubt know of instances where small tools and jigs are considered as plant betterments which are charged to assets, when in reality they are items of expense and should be so charged as they have no market value other than as scrap. The result is that if a manufacturer has $5,000 worth of small tools and jigs and he classes them as assets, his resources are in reality $5,000 less than he thinks they are, while his expenses are $5,000 more than his books show; so that he is simply cheating himself. A manufacturer once told me that he did not believe in figuring depreciation into his expenses, and it is fair to assume that if there is one there certainly must be others who incline to the same view. Business men who believe this way certainly cheat themselves with a vengeance, for their books will show false profits by amounts equal to what the depreciation should be, and they either refuse to figure it into their expense because of ignorance—which is inexcusable—or in order to record a better showing then actually made—which is criminal. While foreign to the discussion, it might not be out of place to show *why* depreciation should be figured into the expense account.

A workman, whom we will consider as a machine, is hired and receives wages *after* the work is performed and the business must absorb this expenditure, in order to get at a total cost; the amount being charged as a cost to the particular orders he may work on, if he is a productive worker, or to the proper general expense classification, if

he be a non-productive worker. This is conceded by all. Now as regards the machine, let us consider it as being *bought* instead of *hired, purchase money* instead of *wages* being turned over *before* the work is performed; the only possible result of this consideration is the conclusion that the business *must* absorb this expenditure also, during the life of the machine. If a manufacturer should hire a man for ten years and agree to pay him $12,000 *in advance,* would he not charge $100 each month against the business? Would he not charge the work performed, if he is a productive worker, with a certain rate when the employee is working, and general expense at the same rate when he is sick? If we then contrast the hiring of a man paid in advance, with the purchase of a machine tool, we have conditions which are the same in both instances, and we must therefore make the business absorb the expense of the tool as in the case of the man, charging the work performed by a rate when the machine is running and general expense when the machine is idle.

The point I desire to emphasize is simply this—*do not stand in your own way.* Conduct your business in the best and most careful manner—do not let a dollar creep into the expense account that should be to your credit in the bank—make your competition what it should be; and while it has been said: "a man always believes more readily that which he prefers to believe," a manufacturer, in the majority of instances, will be more successful if he will simply ask himself the question: "How do I know that I am not getting maximum results?" In his attempt to answer this self-imposed question, he will invariably begin to feel that after all a man is in no position to determine the merits or criticise the value of something about which he knows nothing, and will put aside partiality for his own and prejudice against other methods in order to be in a position to judge intelligently.

Business is conducted for profit and must of necessity be conducted *at* a profit in order to make it impossible for the "receiver" to take over the management of affairs. The margin of profit can be so small as to be easily wiped out through lax and careless methods, while it can never be so great as to make it impossible for the best of management to increase it to a slight degree. The margin of profit, however, depends upon the manufacturer himself, although he cannot accomplish what he desires (and all desire a maximum profit) without depending upon something that will enable him to obtain the greatest amount of efficiency from his workmen and machinery. This something we will call "organization and supervision," for it will be found in the larger industrial plants, where a maximum

production is obtained at a minimum cost, that the details regarding organization have received careful consideration from able and high-priced men, and that intelligent supervision occupies a most important place as a result producer.

In analyzing the seemingly complex industrial body, the purpose of which is an output, the measure of success its percent of profit on cost, we find production dependent upon two fundamentals:—

Production { Labor
Material

Looking still further, we find them subdivided as follows:—

Material { Raw
Finished.

Labor { Productive
Non-Productive

We can therefore define our production as being the outcome of a process of evolution of materials from their raw or unfinished state to finished units, through the instrumentality of labor which devotes its entire time to the producing—productive labor—assisted by labor which, while producing nothing, is necessary in order that the product may be processed and marketed most economically—non-productive labor.

We find these units, whether they be refrigerating, saw-mill, electrical, planing-mill, power, starch-making, hoisting, mining or other kind of machines, divided as follows:—

Units { Standard Units { Standard and Special Parts or All Standard Parts } Various Operations
Special Units { Standard and Special Parts or All Special Parts } Various Operations

Before we can bridge between the operation and the completed unit, the largest proportion of all work must go through two stages of development:—

Machining or processing.
Assembly or erection.

In a small establishment, this machining may be done in one department or, depending upon the size of the business, we may have a department for the lathes, one for the planers, the milling, slotting, etc., may be done by another, the drills may be in one place by themselves, while the laying out of work from drawings may be done by one department, or each department may look after its own laying out.

We have the complete unit which is the outcome of an assembling process, a number of parts being required which have to pass through certain processes of machining, or operations, before being in the proper state for assembly with one another. It is therefore evident that the more the parts that go through the various operations of machining in a given time, the greater the number of completed parts ready for final assembly. Now if we can picture a shop containing two workmen—one to do the machining and another to do the assembling—with a man in charge, and follow two parts, say a forging and a casting, from the forge and stock room to the car, we shall have an example of a supervision of the highest order; for it would be an easy matter for the man in charge to follow the parts, from their receipt as raw material, through the stock room and blacksmith shop, the layout floor, the drills, lathes, etc., thence to the assembly floor, through the process of erection, to the car, keeping in touch with the situation until the parts reached their destination, with the result that they could be produced at a minimum cost as supervision would *force* them through in the shortest possible time. If we could transfer this same degree of efficiency to a large manufacturing establishment, making it a part of a carefully worked out organization, it would not take long before a maximum production would be the result.

If we know something we can apply this knowledge, as the architect through his knowledge of building materials, strengths, etc., can design a sky scraper. If therefore we know all that it is possible to know concerning the various details connected with a manufacturing enterprise, we are in a position to apply this knowledge successfully and with the expectation of obtaining maximum results, *providing* the application is a diligent one; for the success of any undertaking is in proportion to the care with which the many details are looked after. First knowledge, then diligence—organization, then supervision.

In the handling of any work from raw material to finished product, the most important things we must know are:—

The various parts that go to make up a completed unit.
The operations required to make a part complete.
The tools, jigs, etc., necessary to complete an operation.
The condition of the stock of materials necessary to complete a unit.
When the unit is wanted.
Where the parts are during process of construction.
How the work as a whole is progressing.

LIST OF MATERIAL

DESCRIPTION

One D. D. Machine,

X Style

WANTED April 1st.

FOR Jenkins Manufacturing Company

ADDRESS Buffalo, N. Y.

MADE UP BY F. L. Smith DATE Jany 1 1907

PRODUCTION ORDER # 420 SHEET # 1

SPECIAL INFORMATION

Regular testing instructions apply to this order.

✓	# POS	PIECE NUMBER	NAME	DRAWING NUMBER	MAT'L	PRO. ORDER NUMBER
	2	X 420	Arm Brackets	2160	C. I.	420. 1
	5	X 428	Long Arms	2140	Forge	420. 2
	5	X 429	Short Arms	"	"	420. 3
	1	B 50	Bed	3100	C. I.	420. 4
	2	A 214	Rods	2000	Steel	420. 5

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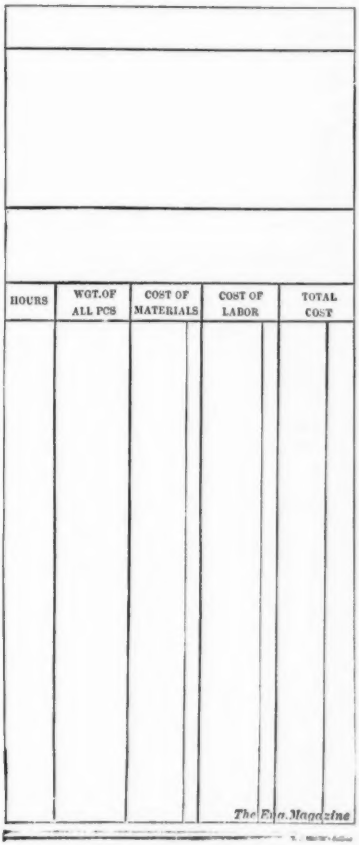
FORM I. LIST OF MATERIAL.

In addition to possessing a knowledge concerning the above points, we must have a means of notifying:—

Works Manager, of orders for completed units.
Foremen, of orders for production and assembly of parts.
Workmen, of the work to be done.
Stock Clerk, of material to be delivered and to whom.
Office, where parts in course of construction are.
Works Manager, regarding condition of any order.
Foremen, regarding parts needing special or immediate attention.



FORM I. COST DATA SLIP.

Further, we must inform:—

Shipping Clerk, regarding promises of shipments.

Office, when stock needs replenishment or to replace spoiled or rejected work.

Foremen, regarding the time spent on work.

As stated in the previous article, any introduction of methods must be made only after a careful study of the conditions. A manufacturer can no more expect to get results from a system devised to meet conditions other than his own, than a doctor can cure consumption by prescribing cough medicine or a nerve tonic. A number of plants manufacturing the same article will have conditions existing in each that are different from those in all of the others; and while principles may be the same in every instance, application must take into consideration the peculiarities and needs of each case. The aim of this series is to consider fundamental principles of organization and supervision, leaving the matter of application to the manufacturer himself. Certain methods are outlined and if the forms and suggestions meet certain conditions, well and good—if not it should not be a difficult matter to adapt them so that they will.

Units are composed of parts—parts take operations—operations as a rule require small tools, jigs, etc., and in order to facilitate processing from raw materials to finished product, detailed information concerning them is important as well as complete knowledge concerning condition of materials.

Regarding the various parts that go to make a completed unit, it

must be known how many of each are wanted, their names, the number of the pattern and the drawing number, the kind of material, and the order number of each part. For this purpose a "list of material," patterned after Form 1 could be used to advantage; it should contain every item that enters into the construction of the completed unit, for the information of not only the office but the shops, and for future reference in case of repairs, etc. A check column has been provided for, the purpose of which will be explained later. To the right of the list and slightly separated from it is a form with five columns to be used for recording cost data pertaining to the various parts. The lists for the drawing room and the various shop departments are printed as shown on page 232, while the list to be used by the office and Cost Departments has the added slip shown on page 233 with the extra columns joined to the main sheet so as to make a complete list. In inserting the sheets into the typewriter—and they should be typewritten—the one for the office can be placed on the bottom with the extra part turned under. If the typewriter has a wide carriage, however, the sheet or slip for the cost department may be inserted as

PART CARD			
Name of part *Bracket*		Number of part *x 43*	
Number of Drawing *2150*		Material *C.I.*	
For what used *#1136 Machines*		Weight *250*	
Tools and jigs *#3 and #40*			
OPERATIONS			
1	*Layout*		
2	*Drill*		
3	*Plane*		
4	*Bore*		
			The Eng. Magazine

FORM 2. DETAILED RECORD OF PARTS AND OPERATIONS.

shown. For standard machines, it would be well to have the lists printed so as to save the work of typewriting.

It is also necessary to have a detailed record of the parts and operations, Form 2, which should show the name of the part, its pattern number, its drawing number, material, for what machine or machines used, its weight, the dies and jigs it takes, and the number and

name of the operations. A complete record of parts is of value to any manufacturer in addition to his pattern record, for while the pattern record cards would be filed by consecutive numbers, the part

TOOLS AND JIGS		
Number *40*	Name and description	
	Clamping Rig	
When made *8/12/05*	For part *x 43*	
Operation *Bore*	For job *#2140*	
Material *C.I.*	Weight *25#*	
Where stored *Shelf #30*	In use *Yes*	
Remarks		*The Eng. Magazine*

FORM 3. CLASSIFICATION OF TOOLS AND JIGS.

card would be filed numerically by machines, thus giving a cross reference.

In order to facilitate the work in the shops, a means should be provided for recording the tools, jigs, etc., necessary for part operations. A place should be provided for these rigs and they should be kept in their places when not in use in the shops. Many an hour has been lost by a man in looking for a certain jig with which to complete an order or operation; but by properly classifying them as shown in Form 3, it will be known what they are for and where they can be found, this knowledge going a long way toward saving considerable time in the course of a year.

After we have arranged for the proper handling and classification of details relating to units, parts, operations and tools, the next consideration of importance is a knowledge concerning the materials on hand. It seems strange that this department of a business should be as carelessly handled as it so often is, for it is a fact that will admit of no argument that there are many manufacturers who while they may have machine departments systematized to a high degree, have stock departments that are most slovenly managed. It will be found in such cases that stocks are arranged in anything but a logical order, a dozen pieces of the same part likely to be found in as many places —no one can tell whether a part is in stock or not without searching for it—the quantity of a certain kind of stock on hand can only be ascertained by counting each time—guess work is the only means of determining the amount used in a given time—work is often held up

RECORD OF FINISHED PARTS IN STOCK

ARTICLE	WHERE KEPT	MIN. TO BE CARRIED	MAX. TO BE CARRIED
Guide Arm	*Bin # 18*	*5*	*15*

DRAWING #	PIECE #	MATERIAL	WEIGHT
3040	*X 540*	*Steel*	*25 #*

RECEIVED				DELIVERED				BALANCE		DELIVERED				BALANCE		VALUE		
DATE	FROM WHOM	ORDER NO.	AMOUNT	DATE	TO WHOM	AMOUNT RESERV'D	AMOUNT DELIV'D	BEFORE DELIVE'Y	AFTER DELIVE'Y	DATE	TO WHOM	AMOUNT RESERV'D	AMOUNT DELIV'D	BEFORE DELIVE'Y	AFTER DELIVE'Y	@	AMOUNT	
5/30	*M.Dept.*	*2140*	*20*	6/2	*3020*		*2*		*18*									
				6/3	*3440*		*4*		*14*									
				6/4	*2160*		*4*		*10*									
				6/7	*1650*		*6*		*4*									
				6/8	*1830*		*1*		*3*									
6/10	*M.Dept.*	*2350*	*20*						*23*									
				6/15	*3321*		*4*		*19*							*1.00*	*19*	*00*

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FORM 4. RECORD OF DATA CONCERNING MATERIALS IN STOCK.

because it was *thought* that the necessary stock was on hand—anyone can take what is wanted without an order or even recording the withdrawal—there is no check against tying money up in excess stock, and absolutely no protection against theft, waste, or mislaying of materials.

It would be hard, in fact, an impossible task to explain why a manufacturer will use the care he does in looking after his cash on hand and in bank, only to show an almost utter lack of concern when money is transferred into material. He would almost have heart failure if anyone would ask him for a dollar with the stipulation that no entry was to be made on the books, and he would not consider such a thing for a moment. On the other hand, so careful is he, that if only a quarter's worth of stamps are purchased, he sees to it that cash is credited and expense charged for the outlay. If he buys $100 worth of material, merchandise or whatever the account may be named is charged, and the person from whom the material was purchased is credited; but how this material is used, when it is used, or where, receives but little of his consideration. If a dollar in the office is guarded with the care that it is, a piece of brass in the stock room, costing and worth a dollar, should receive the same degree of attention; and a workman should have no more right to take this piece of brass from stock without accounting for it than he would have the right to walk into the office and remove a dollar from the cash drawer.

Material is a heavy item to the majority of manufacturers, and it is of the utmost importance that no more material be carried than the requirements of the business call for; it is an easy matter to lose the earning power of considerable money by placing it in stock that is not needed. It should be the duty of a competent person, familiar with the details of the business, to establish a maximum and minimum allowance covering every kind of material used, for the guidance not only of the purchasing department but of the shops as well. This will keep the materials within proper limits, which will mean a considerable saving to any manufacturer. If in conjunction with this we know when stock is disbursed and the purpose for which it is used, we can, if we know what is purchased, easily determine balances on hand, which can be checked against the allowances.

Materials should *not* be given out under any circumstances except by the authority of a written order; and if the proper persons are held responsible, it will be found that the stock department will count for something in the accomplishment of maximum results, for it will be

known what is in stock and the quantity; purchases can be made to advantage; overstocking will be prevented; it will be known which lines are moving in a satisfactory way and which are not; responsibility will be fixed; workmen will find it a hard matter to remove material with authority to do so; mislaid and wasted materials can be traced to those responsible—and in fact, all the important facts concerning materials will be known. Form 4 is shown as affording a means for recording all data concerning materials in stock, the entries fully explaining the method.

Knowledge is power. The most successful surgeon is he who has made the most careful study of the human body—its bones, muscles, nerves—and the most successful manufacturer is he who has made the most careful study of the industrial body—its basic elements, its anatomy, the analysis of its forces, the proper handling of its detail. It is naturally this kind of a manufacturer who realizes his ambition —maximum production.

ENGINEERING ORGANIZATION IN THE BUILDING OF INDUSTRIAL PLANTS.

By Frederic W. Bailey.

The efficiency of systems of organization in industry depends to a large extent on the arrangement of plant for continuous and harmonious working, and a body of literature is being accumulated on the design and construction of industrial plants second only in importance to that of profit-making management. Mr. Bailey's discussion of engineering organization for the purpose of design and construction, however, covers in an admirable manner, a feature seldom touched upon. Without the slightest appearance of special pleading for the contracting engineer, he contends that industrial plants can be designed and built more rapidly, more cheaply, and with more certainty of efficiency of operation by a firm of general contracting engineers than by an engineering staff superimposed upon an operating organization and subjected to the limitations inherent in the aims and principles of the latter. Mr. Bailey has seen large works executed under both systems, and knows at first hand of the conditions which he describes.—THE EDITORS.

MUCH has been written of late years concerning shop methods and systems of organization for specialized engineering work; but little is heard of systems of organization for general engineering work. It is often a cause of comment that firms of mechanical engineers and contractors who have no shops of their own and who, therefore, manufacture nothing of themselves, are so frequently called upon to design, build, and equip industrial plants for manufacturing companies. An industrial company must acquire in time a vast amount of information concerning the best design and equipment of plants to suit its particular requirements, which no purely engineering company could be expected to have. Why is it then that engineering companies are called upon to produce industrial plants for operating companies?

It is the purpose of this paper to show that engineering companies, because of their superior organization for this class of work, by using the information and experience of the industrial companies and by following the industrial companies' wishes as to what the finished plants should be, are able to turn over to the industrial companies more satisfactory plants at a less cost than the industrial companies are likely to build for themselves. It is also the purpose to show that, because of the characteristic organization of an industrial company and the consequent training of employees, it is improbable that an industrial company will do general engineering work on a large scale with wholly satisfactory results unless it appropriates for the work the engineering company's system of organization.

Let us follow the growth of a firm of mechanical engineers and contractors (mechanical engineers because the ultimate aim is a certain mechanical equipment) and note the organization which it builds up to do its work; remembering that every order or contract which it executes is for a shop, mill, factory, or power house which in many respects differs from every other shop, mill, factory, or power house in existence, and that this class of engineering work is, therefore, a purely made-to-order one.

Suppose that a mechanical engineer starts out for himself, in a small way, to design and construct industrial plants. We will say that he gets a small contract. He hires a draftsman, a stenographer and clerk, and a good all-around construction man. The engineer will watch over and instruct the draftsman, will attend to the correspondence in connection with the purchase and delivery of materials and equipment, will also look after the inspection of such material, and will keep a general oversight of and direct the field work. Soon, perhaps, the duties become too great for the engineer and he gets an assistant who chases up the odds and ends of detail in connection with the different branches of the work.

After this contract is finished, let us suppose that the engineer gets two additional contracts. He will then take charge of one himself and put the assistant in charge of the other, keeping a general supervision over him. As time goes on, let us suppose that his business increases and he has several engineers working for him, each of whom is in charge of a separate contract, while he has the general oversight of them all.

Now we have a general engineering organization. The drafting room is under a foreman, who details men to work for the various engineers as their requirements demand. He keeps general track of what each draftsman is doing, and while he has no regular authority in matters of design, he is of great assistance to the engineers because of his knowledge of the design of all the company's work. While this foreman is wholly subservient to the engineers in matters of design, he is supreme in the drafting room in matters of discipline, record, and methods of doing drafting work. The cost of making drawings is always under the foreman's scrutiny.

A construction superintendent, like a draftsman, is working, first for one engineer on one contract, and then for another engineer on another contract. These construction men are hired by the chief engineer and report to him after the close of a job, when they are turned over to other engineers and go onto other jobs. Each con-

struction man, therefore, so far as the contract he is working on is concerned, is working for the engineer in charge of that contract. All his correspondence is with that engineer and all his instructions are received from that engineer.

The clerical work of such a company is handled by one general department. An engineer having carried on the preliminary correspondence and having decided what material or equipment he wishes to purchase, sends a requisition to the order clerk stating exactly what the material is, from whom the material is to be bought, what the price is to be, where and when it is to be shipped, and to what contract and division of contract it is to be charged. The order clerk or head of the order department has no authority over the purchase of material, but simply sees to the making out of the official orders as instructed by the various engineers. He has, however, complete authority in the management of his own work and can demand from engineers compliance with his rules for the systematic running of his department. He is unofficially of great assistance to the engineers because of his familiarity with dealers and prices. Various branches of the clerical department take charge of the checking of bills (after material has been inspected and approved by the engineer or his erecting man) and the auditing, paying, and charging of the same for all the contracts on the company's books.

This, then, is an organization built around the engineer; making him as free as if he were working for himself, but giving him every assistance that is possible. The engineer has just two persons to look to, the chief engineer and the customer. This organization is perfectly elastic. If enough engineers can be developed or hired, it can take care of twice or ten times the volume of work without any confusion.

When a contract is to be let, the chief engineer and the engineer whom he designates look the ground over, get what information they can, and the engineer proceeds to make a detailed estimate. This estimate is subdivided in such a way that it will be useful not only during construction but also as a matter of record in making subsequent estimates. The estimate is approved by the chief engineer and upon it a proposal is made. If the bid is successful, the engineer starts to work on the contract with the estimate always before him so that he can be sure at any time of just where he stands as regards costs.

Specialization of course, is made use of in such an organization. If an engineer is successful in building one class of plants he is usually kept at that class of work. There will also be architects,

structural engineers, and electrical engineers. Each of these men will take charge of his own work, including designing, purchasing, and erection on a number of contracts; but on each contract under the supervision of the engineer for that particular contract. Thus a structural engineer will be in consultation with, and receiving instructions from, one engineer on one contract and another engineer on another contract. As an instance of the use of specialists with such a concern, the case may be cited of a firm of engineers who were building many railroad repair shops and who took into their employ a railroad master mechanic to choose and arrange the equipment for these shops.

The general engineer watches over the draftsmen assigned to him to see that his designs are being put through. He is watching over the specialists to see that all is in harmony. He is shopping around buying material or equipment not ordered by any specialist. He is in constant touch with the erecting force, receiving and scrutinizing their daily letters and reports, writing letters of direction, and frequently spending a day or two on the job. Every complaint or delay is reported directly to him and he is in touch with and responsible for every bit of the work. The engineer is, of course, frequently in consultation with the chief engineer, and he keeps constantly in touch with the representatives of the company for whom the work is being done.

A draftsman for such an engineering company differs radically from a draftsman with a machine company. In an engine shop, for instance, the draftsman is also a designer. When once the general design of an engine has been settled, he works perhaps for weeks without much supervision, getting out the drawings. With the engineering company the draftsman is a draftsman pure and simple; merely an intelligent medium for putting another's ideas on paper—merely an engineering book keeper. He is watched over daily, and perhaps hourly, by the engineer and the foreman. All plans are discussed over the draftsman's board by the engineer and foreman, and frequently by the chief engineer and the customer. In detailing a given machine there are a certain number and sort of drawings that must be got out for the shop and they cannot be varied greatly. In detailing an industrial plant there are an infinite number of drawings that can be made, all costing real money, and it is for the engineer and foreman to decide just what drawings should be made to insure proper construction on the one hand, and drafting-room economy on the other. To get these results it is necessary that there should be

constant supervision by some one having an intimate knowledge of the conditions under which equipment is to be purchased and under which construction work is to be carried on.

With such an engineering company young technical graduates usually spend a year or so in the drafting room, a year or two on construction work, and after this they return to the office as assistants to engineers. These assistants are recruited from such men and from exceptionally capable draftsmen and construction men. An assistant engineer looks after any and all details to which the engineer on a certain contract may assign him. Eventually, if an assistant develops properly, he is put in charge of a contract for himself and becomes a full engineer.

Let us now look at the operating organization of an industrial company, remembering that the work is always repetition and the product is hundreds, or thousands, of articles of a few similar varieties, or else tons upon tons of the same product. We no longer (as a general practice) buy articles for household or commercial use made just as we might specify them, but we buy from stock the articles which come nearest to filling our requirements. Most industrial plants, therefore, turn out a ready-made product.

The whole scheme of an industrial company's operating organization is based on specialization. Every step in the process of producing a certain given article is performed by a separate department knowing its own work thoroughly, but, perhaps, knowing comparatively little about the work of other departments. Take, for instance, a machine company. Here, besides the general office force, there will be the purchasing department, the selling department, the drafting room, the pattern shop, the foundry, the machine shop, the erecting shop, and the shipping department. Any such specialized system of organization is of gradual growth. Such a system represents the result of years of thought and the experience of many men as to the most economical way of performing the same series of operations over and over again. Such an operating organization is a rigid machine, made up of various human beings and machines bound together in such a way that it turns out its own peculiar product economically; but it is utterly unadapted, without changes, to turning out any other product.

The foremen and superintendents in any industrial plant have for their chief aim the keeping up of the quantity and quality of their product, each in his own department. The general system of the plant has been carefully worked out and the lines of demarka-

tion between the different departments are rigidly drawn and the heads of the different departments have very little leeway. If every condition is ideal and every workman knows what to do and does it, there is very little for the heads of departments to do. It is because conditions are never ideal that these men have plenty to do. These men are, therefore, emergency men. If things go wrong, they must know what to do and act quickly, but otherwise the work is mainly routine.

The men at the head of such industrial organizations, while they have a broad knowledge of their own business, have, perhaps, comparatively little knowledge of other businesses. They have, perhaps, risen from positions as heads of departments and the principles of specialization have been drilled into them from their youth up.

Suppose that an industrial company decides to organize its own engineering force and do its own engineering in connection with the enlargement of an existing plant or the building of a new one. In the first place, the heads of the company doubtless believe that theirs is the most difficult of all businesses to manage, and having managed theirs successfully, they can manage any successfully. In the second place they have the operator's contempt for engineers and for engineering. As a successful manager once said: "Almost anyone can build a plant, but the difficult thing is to operate it." Engineering to them is a necessary evil. It is not a source of profit, but rather of loss. It is a sort of heathen god which must be propitiated before a plant can be put in operation.

Such a company has done more or less building and rearranging in the past. At first it was done perhaps with their regular repair workmen, with no plans and just verbal instructions. It is surprising what good work has been done, perhaps is being done, with no drawings. Later, perhaps, such a company employed an architect who made general plans of the buildings which were built by contractors; but there are many gaps between an architect's plans and a finished industrial plant, and so finally the company decides to have its own engineering force to do this sort of work.

As such a concern knows what it wants in the way of plants, is skilled in management and organization, all that it needs is skilled workmen in the various branches of engineering and it is ready to do business. Designers and draftsmen will be got to prepare drawings; business men with some knowledge of engineering to buy material; construction men to erect the work. I have seen a manufacturing company starting in business, having acquired an old plant, begin,

as if by instinct, to form these three distinct departments when they began to enlarge and reconstruct their plant.

To show how improbable it is that an industrial company will use any but a department system in their engineering organization, just think what would happen if it were suggested to the head of such a company that engineers be allowed to purchase their own material. Immediately his mind would turn to similar conditions in the plant. He would see foremen and superintendents corresponding with various concerns and buying brooms, waste, oil, and the various other mill supplies from different concerns. He would see endless confusion and inefficiency, and would instantly reject the proposal, saying that as the purchasing department bought all supplies for the plant it should buy all supplies for engineering.

At first when the volume of work is comparatively small, this department organization does very well. The heads of the designing and purchasing department and, if the work is near at hand, of the construction department, are all close together and all are in touch with the management. No very definite rules are laid down; there is a good deal of freedom of action; each is familiar with the work of the others and they get along very nicely.

When the volume of the work increases the difficulties increase in a greater ratio. The several departments become more separated from each other and communication between them becomes more and more laborious. Each takes a certain share of the work as decided by arbitrary rules. When errors or misunderstandings occur it is a slow, tedious process to trace the records in one department and another so they may be corrected.

The drawing room makes drawings without being in touch with the actual field conditions or with all the conditions under which material and equipment are purchased. Draftsmen often take infinite pains to detail work when the detailing is absolutely unnecessary, and leave undetailed work, which if detailed would save much labor in erection. The purchasing department often buys material without having a very clear idea of what the drawing room is planning, or what the actual field requirements are. While such a purchasing department can buy material like cement, sand, stone, brick, lumber, bolts, or random-length pipe advantageously, equipment like boilers, engines, generators, motors, structural work, and conveyors could be bought more satisfactorily by an engineer who knew just how he was going to arrange such apparatus and how, where, and when he was going to erect it. The purchasing department attends

to all correspondence and all information from the outside world must come through it. If an arrangement of machinery, manufactured by outside concerns, is being made in the drawing room and this arrangement makes it necessary or desirable that the designs of the machines be slightly modified, such a purchasing department becomes an absolute nuisance. Correspondence carried on through such a third party which does not appreciate fully the conditions of the case and does not fully realize the necessity for the interchange of absolutely accurate information, is most unsatisfactory and entails great wastes of time and money.

Delays are frequent, as each department waits for another to act. The whole force loses initiative. A system of order forms, report forms, and rubber stamps is inaugurated and added to till it becomes most complex. Things do not move quickly or smoothly; and this is attributed to lack of system, and the remedy given is red tape. In an operating organization the system represents years of thought as to how one train of operations should best be done. With this engineering organization the attempt is made to devise a system which will perform any series of operations. In other words, the attempt is made to devise a system which will think.

Obviously there must be some system of direction and control of such an organization. This may be accomplished by periodical conferences between the heads of the different departments and the heads of the operating organization. Greater and greater reliance is placed on these conferences and discussions to thrash out every detail of the work. Since no department in engineering is in a position (nor is it trained) to take charge of every phase of any job, the engineering force must depend on these conferences for instructions. Since the heads of the operating organization wish to control the engineering as far as possible, they desire that every detail should be brought to these conferences. An operating organization is accustomed to these conferences and discussions, from the practice of holding daily foremen's meetings. While a discussion is going on at a foreman's meeting the plant is running full tilt; but while a similar conference is held on engineering, everything under discussion is at a standstill. In a foreman's meeting of an industrial organization, a very trivial thing may be discussed to advantage because, when repeated (as it will be) a great number of times, this repetition makes it an important thing. In engineering there is no such general repetition, and details will sometimes be discussed in these engineering conferences which are ridiculously trivial. These

conferences gradually become the designing medium. While designing with a firm of engineers is a constructive process, designing here becomes a destructive process. Acceptable designs are got by a process of elimination, by sending back to the drawing room drawings which are not acceptable, so that eventually one that is acceptable may be produced.

It is up to no one person on each job to think out the sequence of events for that particular job. Some parts of the work are finished quickly, and are of no practical value until other forgotten work is done. The men in the various departments have too narrow a vision to see the whole work in perspective and to judge of the relative importance of the different parts; nor are men of operative training likely to see it. If a steam-engine designer is getting out a new engine, he spends weeks over the general arrangement of the machine. He works out the correlation of all the parts on paper and in his mind before he begins detailing any of them. In this form of engineering organization, the tendency is to flit mentally from one end of the plant to the other, getting out this detail and then that detail, and these details may be more or less duplicates of one another. An enormous quantity of drawings may be made, but when it comes time for erection a good deal of redesigning is necessary to make things fit together in the field.

To the engineer with an engineering company, each problem resembles, in a general way, a mathematical problem. For a satisfactory solution he must first take into consideration the general conditions imposed. There are certain fixed constants which must remain fixed; there are certain variables which may vary within certain limits. With a clear understanding of the conditions, the engineer tries to get at the best solution for the particular case at hand, and having control of every part of the work he can thoroughly appreciate the limitations. Under the department system, the lack of training, experience, or power of control precludes any one person from stating and solving a problem as an engineer does, and the usual procedure is to cut and try until a fairly satisfactory result is arrived at.

If such an industrial company is enlarging its plant and already has a repair shop and repair mechanics, there is a chance for added inefficiency. It is very easy to get in the habit of making this and making that thing in the repair shop, although as good or better articles could be bought in the open market at a lower cost. The repair shop is fitted to do any job of repairs which emergency may

bring to it; but it cannot be expected to do any one class of work as cheaply as a highly specialized shop, which is fitted to do that class of work alone.

One of the great factors which develops the foresight of engineers, and has developed the art of making drawings, with engineering and contracting companies, is the rise in the rate of pay of construction mechanics due largely to the unions. Every effort is made by an engineering company, by means of detailed drawings and by so ordering material to arrange that as much work as possible is done in specialized contract shops, so that as little labor as possible will be needed in the field. When plenty of low-priced mechanics are at hand, however, these economies are often not made use of. Although cheaper in rate of pay, it is not possible to push repair mechanics as construction mechanics are pushed on contract work, and industrial companies frequently cannot do work as cheaply, in spite of their lower priced workmen, as contractors can.

The training of men in the various departments is of necessity narrow and there is very little opportunity for them to shift from one department to another. Few of these men are likely to be technical graduates, for the reason that the heads of such a concern will consider a bright young technical man much too valuable to waste on engineering. Such a man may work for a year or so in the drawing room, but after that he is usually transferred to the operating side of the business.

Such an engineering organization as has been described is sure to produce jealousies between the different departments. Each feels in its heart that it is the most important department. The men in the drafting room are now designing engineers. In the purchasing department the men are purchasing engineers, and in the construction department they are now construction engineers. There could be designing electrical engineers, or purchasing mechanical engineers, and why not checking engineers or blue-printing engineers, since the titles only show how little of the real engineer's work each one does?

To show what jealousies may arise from the division of engineering work among a number of special departments where authority interlaps, let us take the example of the United States Navy. The Washington correspondent of the New York *Times* in a despatch describing a dispute between two of the bureaus in the Navy, dated December 26, 1907, says: "It (the dispute) shows two of the seven bureaus engaged in a bitter struggle for more power, each forgetting

the real interests of the service in striving to expand its own, at the very time that it alleges the real interests of the service as the motive for its action. . . . . Everywhere they went the congressmen (investigating committee) found work tied up by conflicting orders from different bureaus. . . . . Each bureau had its own men on the ground to see that the strategy of their chiefs in Washington was fully carried out." While the organization of even the engineering side of the United States Navy is a much more complicated problem than that of an industrial company's engineering force, yet the two have some points in common. Both try to produce a made-to-order product with highly specialized departments which interlap as regards authority and neither has to show a profit directly.

The cost of engineering with such a system as has been described runs up enormously, although one of the original reasons for the organization of the force may have been to cut out the profits of engineering and contracting companies. Estimates are perhaps made for the sake of getting appropriations, but the value of making accurate estimates, carefully subdivided, before any work is begun, of keeping within these estimates during the progress of the work, and of carefully filing away the results of such work for a basis for future estimating, is usually lost sight of. Worst of all, there is no competition in such engineering. There is no rival to underbid, and so there is no basis of comparison with the cost of outside engineering work. The tendency is always toward more expensive construction though the returns may not warrant the extra expenditure. The dollar sign has been removed, and of all the signs and symbols used in engineering it is the most important. Take away the question:—"Will it pay?" from engineering, and reason and control are gone. It is like removing the governor from an engine. The engine will go, but where will it stop?

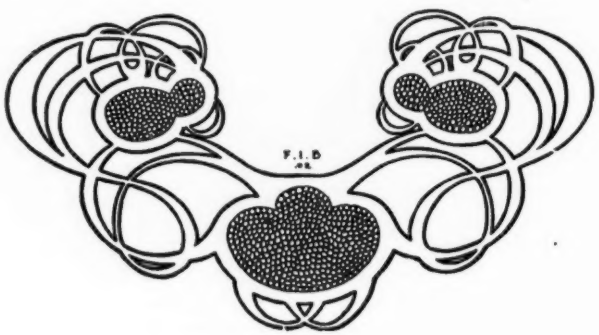
Such a system, of course, will eventually hang itself. Plants will finally cost so much to build that they cannot be operated at the profit which competitors make. Finally, perhaps upon the consolidation of several plants, a broader view of specialization will come to those in control, and it will be seen that true economy lies in letting engineers build the plants, while operators confine themselves to operating them.

Perhaps now an engineering company will be called in; but if the industrial company cannot or will not do this, it will at any rate follow the engineer's system of organization. Either by incorporating a subsidiary engineering company, or by other means, engineering will

be put on a level with operating and so separated that it can show its own profit. The engineering work will be in charge of engineers who have been trained to do good work at a profit. Such men will respect the expert knowledge of the operating men as to what the finished work should be, but will refuse absolutely to let operators say how this result shall be attained. They will realize the value of repair shops and repair workmen to do repair work, but will carefully avoid them on construction work. Best of all, such engineers will see that the separate-department system is wiped out and that a system of doing made-to-order work in a made-to-order way is inaugurated.

This whole problem of engineering organization has had its counterpart in hundreds of lines of manufacture. In old times the shoemaker took the measure of a person's feet and from the raw material produced a pair of shoes. If business increased, a number of workmen did the same thing; each worked on a distinct pair of shoes. When someone discovered that human feet and human tastes could be standardized, machines were invented, factories built, and now one workman performs just one operation on thousands of shoes.

When we can order our electric railways, power houses, mills, factories, and machine shops from such and such a page in a catalogue, to be shipped from stock, knocked down, with all parts carefully numbered and accompanied by printed instructions so anyone can erect—then, and not till then, will the highly specialized, ready-made organization supersede, in general engineering, the present efficient made-to-order form of organization.



OBTAINING ACTUAL KNOWLEDGE OF THE COST OF PRODUCTION.

By F. E. Webner.

I. WHAT CONSTITUTES A KNOWLEDGE OF COSTS.

Mr. Webner's series beginning this month will extend through six parts. The successive topics will be: When and where a close knowledge of costs is needed, dealing with ordinary weaknesses and their disclosure; comparisons of costs and the profitable use thereof, treating largely of the overcoming of weaknesses in economy of manufacture; the use and abuse of mechanical aids in cost finding, discussing such appliances as directly as possible without exploiting any particular product; the organization of a cost department, covering the fitness of the men needed and the apportionment of the clerical work; and cost records as a constituent element of the general accounting plan, bringing out the opportunity and the means for accomplishing the desired end without top-heaviness. The articles are characterized throughout by freshness of viewpoint and originality of treatment. The authority of their writer needs no restatement.—THE EDITORS.

HUMAN nature enters very largely into all phases of business practice and is a factor of no mean importance to be considered when dealing with either hypothetical or physical conditions of a factory proposition. Among his associates outside of his office the manager of a modern (or even a more or less ancient) plant will swell with pride as he relates the results of efficiency tests made of his machinery, his engines, his boilers, his fire-protection equipment—the high quality and values of his raw material and finished product. Of his personal possessions he will oftentimes expatiate, and frequently exaggerate as to values; though with no intention to boast it will be made to appear as though his motor car were absolutely peerless; his horses' veins coursing with the bluest of blue blood; the interior decorations of his house more costly than the usual run of houses in his class, etc.

These feelings of satisfaction and pride often expressed tend to exaggerate true conditions in the mind of the manager, to a point where he unconsciously believes the magnified impressions to be facts and would dispute the accuracy of figures in a statement showing otherwise. That is the result of an optimistic view of conditions more often experienced when the morning mail brings remittances and the afternoon mail brings orders. The roseate hue fades to a considerably less brilliance when the tax assessor's list is left for the listing of possessions and affixing of values.

To the salesman of accounting devices or advice, the average manufacturer will declare in good faith that he is possessed of a close knowledge of his affairs, and particularly of the cost of his product; one manufacturer may say that he contracts for his raw material on an annual basis and that therefore material prices do not fluctuate with him; that he employs his shop hands altogether on a piece-work basis and therefore knows his labor cost in its minutiæ, and that his overhead expense is quite readily distributed over product on a given percentage of labor cost. Another manufacturer may say that his records are kept so that his material, labor, and expense respectively are known for each department of his plant, and that estimates can be made of the individual articles of product coming from such department. A third manufacturer will say that he has a specialty or by some manner or means enjoys a condition of affairs wherein competiton is practically eliminated, and that while he knows he is making money he is satisfied with results as they are and does not need to know his costs any closer than he already knows them. Again, manufacturers have been heard to say that conditions and costs are known to them, but a greater source of worry is the inability to increase the volume of product without materially increasing the investment in plant account. And so the arguments run; many of the manufacturers may have equipped their office with every good accounting idea which has come under their notice and yet they are in many things away wide of the mark. Human nature prompts the manager to refute any insinuation that his plans are not of the best, and yet in the inner councils of his staff oftentimes there are shortcomings brought to an apparent existence, but their exact location and remedying is a puzzle which for the moment puts the existing accounting plans in the same category as the tangible assets when considered on a tax-appraisal basis, and exactly the same question is considered, namely: of how much real value are they?

While the assessor is on hand to aid in affixing high values to the assets, the manufacturer must alone be the final judge as to the value of his accounting plan.

A cost system which has as its ultimate aim and object the disclosure of the fact that a certain unit of production cost a certain amount of money, may serve a more or less valuable purpose; but primarily the cost of installation and maintenance of such a system is an item of expense. A cost system which has as its ultimate aim and object the disclosure of data showing *why* the unit of production cost what it did will serve as valuable a purpose as the management

may choose to make it, and the first cost of such a system might well be classed as an asset rather than an expense and its upkeep will far more than pay for itself.

A good cost system is a tool for cutting down costs, and like other tools it must be kept in good condition to insure a high degree of efficiency. That manufacturer who is satisfied with his results as they are, who perchance is in the class whose product is a practical monopoly, sees no crying need for a cost system; his money is made not in manufacturing, but in the wide margin of exaggerated profit accruing to him by reason of prestige brought about by invulnerable patent rights or purchased friendship. Such a concern is gunning for eagles, so to speak, and not for sparrows; and the savings brought about by means of a more or less intricate cost system make it appear too hard work to make money by mere manufacturing processes. As a matter of fact, such a concern might, in the majority of cases, "farm out" its work to a closely watched factory at a considerably less cost than its own cost of production.

Where material, labor and expense costs are applied synthetically against a department as a whole, and not against individual shop order numbers, close costs are not obtained even though the sum of the various estimates may exactly absorb the totals in each cost element; there is no means of proving that some orders are not over-estimated and others under-estimated—in short, it is the application of the law of averages and nothing more. In the use of the law of averages in that manner the material element is the most easily determined, inasmuch as the exact amount of material in the unit can be measured and the exact amount of waste material can be determined by inventory processes; the cost of the element of labor is more or less of an *ignis fatuus*—it seems to be located but it isn't; here the human-nature element of the employee is to be dealt with, and here very often lies the difference between profit and loss in individual shop orders. I believe that workmen as a rule are honest, or at least that they think they are and mean to be, and yet every manufacturer knows the shortcomings of certain classes of individuals in the great labor army.

The man who holds back his output for a certain effect; the rapid but not careful man who makes mistakes which may or may not be discovered; the clock watcher who refrains from taking up the next job for the reason that some time in the near future the whistle might happen to blow; the "soldier" who is exceedingly deliberate in his actions and who makes frequent and prolonged visits to the toilet

room; the putterer who fusses with his machine much longer than necessary—are all familiar to the manufacturer, as are a number of other classes not necessary to enumerate. Men of undesirable characteristics are naturally weeded out as fast as possible, yet no factory has a force which is the height of perfection—every factory needs a superintendent and foreman, and unfortunately these worthies are often found to have, besides the qualifications which commend them, certain undesirable features such as are at times found in the workmen. It is a well-known fact that two different foremen, with the same force of men and the same conditions, can produce widely different volumes of output and efficiency, and both foremen have the respect and friendship of the men and the management and in neither case can the foremen nor the men be considered more or less dishonest in intent than in the other case.

While corporations are characterized as soulless, yet oftentimes pensioners are found in factories where in truth their absence would do more toward dividend making than their presence; these pensioners may be in positions anywhere from the top down, but whatever the cause or effect may be in any of the foregoing, the cost is undisputedly there, and while an effective cost system may disclose startling facts the cost system *per se* cannot correct them.

On the estimate plan the labor cost on a given shop order is estimated either at about what length of time the various operations ought to take, or time is kept by or for the men, usually under conditions that are not normal; that is to say, the men knowing that they are for the time being watched will naturally "hit 'er up" at a livelier pace than is usual with them. In this connection the thought comes to my mind of a factory in New England where lot order numbers followed seriatim through a number of different departments; about once a week a so-called test was made which really was but a farce, as it was no fair test at all; for when the edict issued that a certain order number was to be a "test" the word was quickly passed along the line to all concerned and all possible preparation was made to speed the work through with as little delay as possible.

In cases where employees make out time reports each day and actual starting time and finishing time is not recorded, but where the employee apportions whatever time he chooses to the individual jobs on which he worked, such time reports are little better than the guesses which the foreman himself might make; such reports usually omit any reference to dead time between jobs, time spent on cleaning machines, shut down of power, spoiled work done over, etc. In cases

of this kind it is within the province of the employee, and it is quite human nature, to equalize the report as much as possible, and he does not consider himself dishonest in so doing. Labor means the expenditure of cash and is therefore equivalent to cash, yet the average management draws more strict lines on the cash records than on the labor records. A close knowledge of costs of production hinges in a very large degree upon the accuracy of the labor reports and records, and in that connection piece-workers are identical with time workers in that the maximum capacity of the factory is not reached unless all workers are making the very best possible use of the facilities at hand. With two piece workers getting the same labor price per unit, superficially it would appear that the product of each cost the same; this, however, is not so if one does more than the other—the work of the slower one would have to absorb more burden than the work of the faster one.

The element which gives the most real worry in accurate cost finding is manufacturing expense, which includes fixed charges of various kinds, non-productive labor and other direct charges, also reserves for depreciation, repairs and renewals of plant and machinery, and numerous items under what has been called "invisible expense." It is not the purpose of this article to treat with the various and several items which make up manufacturing expense, but merely to touch upon that phase of it which has to do with diffusing such expense over product. The formerly practiced plan of spreading the expense burden over product on a percentage of material or labor costs is as absolutely wrong in theory as is the child's idea that a pound of lead weighs more than a pound of feathers. The cost of material and labor, either jointly or separately, bears no relationship whatever to the amount of expense to be distributed; and the only point about either material or labor that does affect expense is the amount of time consumed by labor in accomplishing the desired end.

Primarily, manufacturing expense for a calendar month or four-week period should be equitably segregated over the various departments of the plant, then in turn the expense of each department segregated over each machine and bench in the department, and the expense on each machine or bench divided by the number of working hours in the month to find the cost per hour. Every job done on a given machine should stand a charge or rental, so to speak, of the actual time such machine was used. Dead time of the machine should be charged against a reserve account and finally find its way back into the diffusion process as a cost like the cost of a workman's dead time.

For those factories or shops where the finer division of cost elements is a new venture, what is known as the "departmental man hour" will be adequate and come fairly near the truth. Into the total amount of manufacturing or overhead expense is divided the total number of productive hours in the department for the calendar month or four-week period, thus obtaining a constant per hour, which is applied to every job done in the department by multiplying the constant by the number of hours consumed, thus obtaining a just and fair burden.

If the starting time and finishing time is required on every job then facts are known and not guesses. There are many good devices on the market for recording time, and although the first cost may seem heavy, the installation should include enough machines so that the workmen need not consume more than forty seconds to register and return to work. By the aid of modern machines the elapsed time and money value of the tickets can be computed and printed in one operation by a bright boy at a small cost.

All the information regarding time is likely to be of no actual benefit unless it is made use of by means of comparisons of time consumed, costs involved, dead time, non-productive, etc. It is not necessary for the foreman to handle these time reports, and perhaps it is better that he does not, as they are going to tell many things, some of which more than likely will reflect upon the foreman more than on the workmen. In these cards are hidden the secrets of cutting down costs by raising the efficiency of workmen, increasing the volume of output without the installation of additional machinery, and in short getting the maximum in results with the minimum cost.

EDITORIAL COMMENT

Efficiency in Manufacturing.

IT has been frequently remarked that the electrical industry does not suffer in the same degree as others from conditions of general depression. The reason lies in the fact that though large power or traction undertakings may lag, the introduction of smaller applications of electric driving is stimulated by the sudden awakening of a demand for better economy in manufacturing. The electric motor for group (or still better, individual) operation of tools or machines affords opportunities which demand realization, and the enlargement of such uses thus makes a concrete, visible measure of the attention that owners and managers are giving not merely to turning out product in maximum quantities, but to finishing it at minimum cost.

A time of recession in business is indeed emphatically the best time of all for progression in efficiency. Extravagances which were unnoticed or which were necessary when the works were running at high pressure now become evident and call for cure. Wasteful methods that could not be changed during the rush of an overcrowded season can be replaced by economical ones without seriously disturbing the routine of work on hand. Machines known to be in bad condition and costly to run, but impossible to spare when the plant was overloaded, may be laid off and remodeled or replaced by new. Improvements in power plant, transmission, or special applications are not only feasible but imperative, if they will save money and increase the percentage of net earnings.

With the purpose of making such a lull as exists serviceable for the greatest ultimate profit, THE ENGINEERING MAGAZINE will devote much attention during the next few months to demonstrations of the best means for securing high efficiency in production. The discussion will cover betterment of mechanical plant as well as organization and methods. It will be thoroughly practical, concrete, and specific. The profitable activity of introducing improvements will afford stimulus to encouragement. Its reflex demand upon the great manufacturing industries for improved equipment will of itself be the very best introduction to an era of fuller employment, which waits only upon a little pioneer courage and the support of mutual confidence.

The Museum of Safety Devices.

M. BOYER'S article elsewhere in this issue supplements a group of papers in which we have reviewed some of the most important features of the movement abroad for safeguarding and insuring workmen against injuries incident to their occupation. Heretofore it has been necessary to go to Europe for tangible demonstrations, influential toward positive action, such as the museum of the Conservatoire. It is so no longer. The American Museum of Safety Devices, opened in New York in April, is the hopeful starting point of a better order of things in the humane administration of American industries. From this one we may build to match Europe's ten, if the courage and broad vision of the founders meet such response and support as their effort deserves.

Of the extent and interest of the collection we shall have more to say later in an illustrated article. Our immediate object is to recommend most earnestly the examination of the Museum and its purposes. Necessity limits the present plans to a brief exposition of

the exhibits as now assembled. It would be greatly to the credit—and to the material interests—of American manufacturers to assure a foundation upon which the institution could be permanently established. The signs are plain that changes in the laws of employers' liability are in progress. By intelligent co-operation of all factors involved, these changes may be made wisely and to an end immensely helpful to the stability and the total economy of manufacturing, transportation, and commercial operations. A museum of this character is the natural focus for such co-operation. Its permanent organization may be made the safe governor and balance of the entire movement. Here is the answer to the problems of liability and of insurance which owners and managers may soon find more numerous and more urgent than they are now.

Conditions in the Shop.

THE comment upon American industrial conditions, by a New England machinist, which we published last month, was one of those peculiarly human revelations that arrest even a roving attention. Whether or not the listener agreed with the doctrine, he felt that a man was speaking and he stopped to hear what was said. We have received a number of inquiries and letters referring to the short article, and one reply in particular from another shop-man which we shall put before our readers next month. Like our New England correspondent, this critic grew up at the bench and on the foundry floor. Like him also, he is of the type that preserves the spirit of the old guilds—the spirit that puts mastery of one's craft as the highest ideal of the workman. From the viewpoint of a superintendent, in another part of the country, however, he forms a different idea of the influences working upon the American apprentice or the young journeyman, and especially of the proportion in which they affect his aims and his conduct. This view shall speak for itself next month.

The Apprenticeship System.

IN this connection it is most interesting to note the extension of a realizing sense that employers must take a larger part in the education and training of the new generation of workmen. Unionism, however justifiable its theory, has dwarfed its aims to the attempt to make the workman *get* more —not to make him *worth* more. The attempts to raise the pay of labor by the operation of economic laws, instead of in defiance of them, have come from outside the unions and have generally met with their violent opposition. It seems that the initiative in sane development of so vital a matter as the trade-teaching of novices must also come from the side of the employer.

When we first took up the topic in these pages, it must be admitted the response from manufacturers was not encouraging. It appealed strongly to a select few, and was greeted with scant patience by the many. Education, however, has been rapid. As indicating the advance in one of the most important of our national activities, our attention is called to the novel feature of an exhibit by the committee on the apprenticeship system, which is to form part of the railway Master Mechanics' Convention at Atlantic City. "It is expected," says the announcement, "that all the railroads operating apprentice schools will send models, drawings, and photographs to show in a comprehensive manner the rapid advancement which is being made in this phase of railroad activity." The Central Railroad of New Jersey, the Grand Trunk, the New York Central lines and the Santa Fe have already consented to exhibit. A good strong lump of the leaven of improvement here!

THE LIVE-STEAM FEED-WATER HEATER.

A DISCUSSION OF OUR PRESENT KNOWLEDGE OF THE PHENOMENA OF STEAM GENERATION AND THE UTILITY OF THE LIVE-STEAM HEATER.

The Engineer.

A PAPER read before the Institution of Mechanical Engineers on February 21, giving particulars and results of a test of a live-steam feed-water heater, has brought the unsettled question of the economy of live-steam heating again into prominence in the technical press of Great Britain. The experimenters, Prof. Goodman and Mr. D. R. Maclachlan of the University of Leeds, found that the evaporative efficiency of the boiler was entirely unaffected by the use of such a heater. This result is hailed by *The Mechanical Engineer* as a conclusive proof that the claims made on behalf of live-steam heating are entirely fallacious. To *The Engineer*, however, the result proves nothing beyond the inadequacy of our knowledge of the physics of steam generation to explain the many complex problems connected with the latter. Extracts from the extremely interesting editorial comments of *The Engineer* are given below. They have an additional interest for readers of THE ENGINEERING MAGAZINE if read in connection with the discussion of feed water heating which has run through the preceding and the present number.

"Professor Goodman and Mr. Maclachlan, approaching their subject with perfect impartiality, and, as far as possible denuding their minds of preconceived ideas, arrived at the conclusion that no increase in either the economy or efficiency of a boiler is to be had from the use of a live steam feed-water heater. Under the stated conditions of trial it did neither good nor harm; and on theoretical, limited grounds, this is just what was to be expected. Leaving loss by radiation and conduction out of consideration, water heated by steam taken from the boiler being fed can only return to the boiler heat already taken from it in the form of steam. If the feed-water contains 1000 units of heat imparted to it in the heater, then the boiler has paid for these units. There is, of course, no getting away from this truth. The results recorded in the paper are therefore perfectly consonant with theory. So far, live steam heating is no good.

"On the other hand, however, we have a fact the existence of which is equally certain. Dozens, if not hundreds, of live steam feed-water heaters are in regular use in steamships. They have been in use for about twenty years. They are much liked; the sale of them continues, and they are estimated to reduce the consumption of coal by from 7 to 12 per cent. Nor is this all. The boilers make more steam; the ships make quicker voyages; and there is an all-round benefit conferred by a small apparatus, which, as we have seen, is theoretically wrong. How are these facts to be reconciled? How is the consistence of theory with practice to be made good?

"As the gain cannot be found in the feed-water heater itself, we must search for it in the boiler. Here we enter an unknown land. The process of boiling water is so common, so freely carried on, so constantly before our eyes, that familiarity has bred contempt, and it has been quietly assumed that it is a very simple thing, presenting no physical problems, and truly not worth much examination. Those, however, who have gone a little further into the matter understand that the nature of the processes by which a plate of metal is heated, heat is passed through the plate, taken up by water, and converts the water into steam, are not really comprehended at all, probably because they have never yet received adequate attention from competent physicists. We, of course, cannot pretend to do more here than direct attention to the existence of ignorance due to lack of interest in the subject. Some inquiry has been made, it is right to add, and this inquiry has resulted in presenting problems of such interest that we can only wonder that the phenomena of ebullition, evaporation, and condensation have so long been ignored by those who are racking the universe to extract Nature's secrets.

"If we turn to any physical text-book we shall find figures setting forth the rate of conduction through copper or iron or any other metal, expressed in terms of the number of thermal units which will pass through a square foot of heating surface in any unit of time. From this we learn that copper is a much better material for boiler plates than iron; that the thinner the plate the more rapid the transmission of heat; and the colder the water, the greater being the 'thermal head,' the more rapid will be the flow. Now, so far as the operation of a steam boiler is concerned, every one of these propositions is wrong. The transfer of heat has only the most remote connection with the material of the plate; thus the copper fire-box of a locomotive is not in any way better than a steel box. A plate of either metal ½ inch thick is just as efficient and as economical as one ¼ inch thick; and, lastly, careful experiments made by the late Sir Frederick Bramwell and Mr. William Anderson independently at different times, showed that the transfer of heat proceeded about five times as fast when the water was boiling as when it was cold. Peclet demonstrated nearly fifty years ago that the conducting powers of a plate are so much greater under all circumstances than the absorbing and emitting powers of the surfaces of the plate that conduction may be left out of consideration. It can in no way affect the performance of any practicable boiler. It may be shown, indeed, that if we have two cast iron pots, one about an eighth of an inch and the other an inch thick, they will both produce the same quantity of steam in the same time. The fire side of the thicker pot will, however, become much hotter than that of the thin pot. But the conditions, of course, have no parallel in steam boiler practice.

"What then takes place inside a boiler? To obtain information experiments have been made by fitting glass ends to large model boilers, or glazed sight holes to real boilers. It is true that in neither case can much pressure be carried, but there is no reason to think that the pressure bears any relation to the mode of generation. Under all conditions steam is produced in much the same way. It comes off 'centres' in the plates. There is never, under any circumstances, a generation of steam all over a plate. Furthermore, the points of production may be very few. We have seen vast quantities of steam rising from two points only in the crown of a furnace tube. Every student who has boiled water in a glass flask knows that points in the shape of some roughness are required if he wants water to boil quietly, and when dealing with solutions to avoid 'bumping.'

"But what does this paucity of ebullition centres, the fact that scores of horse-powers may be sent away from areas not larger than a sixpence, involve? What is the nature and method of transfer of energy from the still—that is to say unboiling—water to that which is boiling? The most delicate thermometers can detect no difference in

temperature, and yet violent ebullition goes on in one place and none at all elsewhere in the mass of water in the boiler. So far there has never been any satisfactory explanation of the phenomena of ebullition advanced. If we understood the whole process, and the nature of the heat transfers going on between the various portions of water inside the boiler, we would have advanced at least a step to the knowledge of why hot feed-water should make a boiler more efficient than cold feed-water.

"Leaving now the mere abstract aspect of our subject, let us consider whether there is not some practical way in which we may explain the efficiency of the live steam feed-water heater. It is evident that if a steam generator contains nothing but water hot enough to boil, the whole of the heat supplied to that water must be employed in the production of steam. It is at once converted into latent heat, or, to be strictly accurate, that form of molecular energy known as heat disappears, and is replaced by another form of thermal energy in the shape of steam. It is clear, therefore, that under these conditions the boiler ought to produce more steam than it would if employed in heating up cold water to the boiling point. But of the extra quantity of steam so produced a certain proportion will be expended in heating the feed-water. Ostensibly the entire weight of extra steam available ought to be used up in this operation. If, however, the boiler is more efficient as a boiler than it would be as a feed-water heater, then there will be a distinct gain; and it is easy to see that in that case the gain will be not only in quantity but in economy. Because it goes without saying that the greater the efficiency of a boiler, other things being equal, the greater must be its economy. It is indisputable that so far as heating water is concerned, mixing it directly with steam represents the most efficient and economical system possible, no transfer through plates taking place. In so far there is a distinct gain in that the process of heating the feed-water by live steam is more efficient and economical than that of raising its temperature by transferring heat through the boiler plates. As regards the conversion of the water into steam there is apparently, judging from the experiments to which we have already referred, an advantage to be gained by bringing only boiling hot water in contact with the plates; and, lastly, it is not impossible that the circulation in a boiler into which no cold water is put will be much better than that in a boiler within which large bodies of water may exist at a low temperature.

"If, now, we take it for granted, for the sake of argument, that an economical advantage of 10 per cent. is secured in any boiler, then there must be an equivalent reduction in the quantity of heat wasted up the chimney. It is for this reason that Professor Goodman and Mr. Maclachlan took so much trouble with the products of combustion during the heater trials they carried out. It was on the figures tabulated in their paper concerning the temperatures and characteristics of these gases that the discussion of their paper principally turned. The fact that the Leeds experiments showed no gain from the use of a heater, while experience on an infinitely larger scale at sea shows that there is a gain, tends to teach that there is something about the construction of a boiler which may determine the value or the reverse of the heater. We must not close our eyes or ears to evidence, but consider it with care, and endeavour with patience to fit our facts together, and, it may be, reconcile apparently insuperable contradictions. Thus, to mention one point, it may well be that in one type of boiler the circulation is so good that nothing is to be gained by heating the feed to boiling point, while in another it may be so bad that anything which will encourage it or accelerate it may be of use.

"To sum up, it may be stated as a fact that a large body of shipowners and marine engine builders have for many years used the live steam feed-water heater on some system, and these shrewd business men would be very unlikely to use it if they gained nothing. On the other hand, it does not admit of ques-

tion that there is nothing to be gained directly by live steam heating. To reconcile the obvious contradiction, we must assume that something not understood goes on inside the boiler. Unfortunately we are here launched on a sea of conjecture, because no one at present knows what steam is, or the way in which it comes into being. Thus, it is by no means certain that water can be heated at all, the heat which we feel being that of steam diffused through it, a theory which will, of course, apply to every other substance capable of assuming three states, the moment it has passed the critical stage and becomes a liquid. Precisely what takes place inside a boiler, then, being unknown, all that can be said is that it is quite impossible to prove that live steam heating cannot be used to advantage, while there is a great deal of evidence that it can."

GASOLINE AND ALCOHOL AS MOTOR FUELS

A SUMMARY OF THE RESULTS OF ELABORATE TESTS ON THE RELATIVE VALUE OF GASOLINE AND ALCOHOL AS PRODUCERS OF POWER.

Bulletin of the United States Geological Survey.

A SERIES of tests on the relative value of gasoline and alcohol as producers of power, of more than ordinary interest and importance, has been concluded recently by the Technologic Branch of the United States Geological Survey. Investigations on this subject have not been lacking but the value of their results has been limited, in most cases, both by the small scale on which they were conducted and the restriction of the inquiry which they were designed to cover, and by an almost universal failure to take into consideration all the numerous and varied conditions influencing engine performance. The tests made by the Geological Survey, over two thousand in number, with the original research work which they have entailed, represent probably the most extensive and exact investigation of the kind ever carried out and their results present the most complete and exact body of information available concerning the operation and design of gasoline and alcohol engines. Below is given a summary of the results in regard to the comparative fuel consumption of 73 degrees B. gasoline and commercial completely denatured alcohol, per unit of power, taken from an advance report of the Survey.

Correspondingly well designed alcohol and gasoline engines when running under the most advantageous conditions for each, will consume equal volumes of the fuel for which they are designed. This statement is based on the results of many tests made under the most favorable practical conditions that could be obtained for the size and type of engines and fuel used. An average of the minimum fuel consumption values thus obtained, gives a like figure of eight-tenths of a pint per hour per brake horse power for gasoline and alcohol.

Considering that the heat value of a gallon of the denatured alcohol is only a little over six-tenths that of a gallon of the gasoline, this result of equal fuel consumption by volume for gasoline and alcohol engines probably represents the best comparative value that can be obtained for alcohol at the present time, as is also indicated by Continental practice. Though the possibility of obtaining this condition in practice here has been thoroughly demonstrated at the Government Fuel-Testing Plant, it yet remains with the engine manufacturers to make the "equal fuel consumption by volume" a commercial basis of comparison.

The gasoline engines that were used in these tests are representative of the standard American stationary engine types, rating at 10 to 15 horse power, at speeds of from 250 to 300 revolutions per minute, while the alcohol engines were of similar construction and identical in size with the gasoline engines.

The air was not preheated for the above tests on alcohol and gasoline, and the engines were equipped with the ordinary types of constant-level suction

lift and constant-level pressure-spray carburetters. Many special tests with air preheated to various temperatures up to 250° Fahrenheit, and tests with special carburetters were made, but no beneficial effects traceable to better carburation were found when the engines were handled under the special test conditions, including constant speed and best load.

The commercial completely denatured alcohol referred to is 100 parts ethyl alcohol plus 10 parts methyl alcohol plus one-half of one part benzol and corresponds very closely to 94 per cent. by volume or 91 per cent. by weight ethyl alcohol (grain alcohol). No detrimental effects on the cylinder walls and valves of the engines were found from the use of this denatured alcohol. The lowest consumption values were obtained with the highest compression that it was found practicable to use; which compression for the denatured alcohol ranged from 150 to 180 pounds per square inch above atmosphere.

Eighty per cent. alcohol (alcohol and water) for use in engines of the present types would have to sell for at least 15 per cent. less per gallon than the denatured alcohol in order to compete with it. The minimum consumption values in gallons per hour per brake horse power for 80 per cent. alcohol is approximately 17.5 per cent. greater than for the denatured alcohol used or for gasoline. A series of tests made with alcohol of various percentages by volume ranging from 94 per cent. to 50 per cent. showed that the minimum consumption values in gallons per hour per brake horse power increased a little more rapidly than the alcohol decreased in percentage of pure alcohol. That is, the thermal efficiency decreased with the decrease in percentage of pure alcohol. This decrease in thermal efficiency or increase in consumption referred to pure alcohol is, however, comparatively slight from 100 per cent. alcohol down to about 80 per cent. alcohol. Within these limits it may be neglected in making the calculations necessary to compare the minimum consumption values for tests with different percentages of alcohol.

The nearer the alcohol is to pure, the greater the maximum horse power of the engine. The per cent. reduction in maximum horse power for 80 per cent. alcohol as compared with that for denatured alcohol used was less than 1 per cent., but the starting and regulating difficulties are appreciably increased.

With suitable compression, mixtures of gasoline and alcohol vapors (double carburetters) gave thermal efficiencies ranging between that for gasoline (maximum 22.2 per cent.) and that for alcohol (maximum 34.6 per cent.) but in no case were they higher than that for alcohol. The above thermal efficiencies are calculated from the brake horse power and the low calorific value of the fuel, which for the gasoline was 19,100 British thermal units per pound and for the denatured alcohol was 10,500 British thermal units per pound.

As has been previously published, alcohol can be used with more or less satisfaction in stationary and marine gasoline engines and these gasoline engines will use from one and one-half to twice as much alcohol as gasoline when operating under the same conditions. The possibilities, however, of altering the ordinary gasoline engine as required to obtain the best economies with alcohol are very limited; for the amount that the compression can be raised without entirely redesigning the cylinder head and valve arrangement is ordinarily not sufficient, nor are the gasoline engines usually built heavy enough to stand the maximum explosive pressures, which often reach 600 and 700 pounds per square inch. With the increase in weight for the same sized engine designed to use alcohol instead of gasoline, comes an increase in maximum horse power of a little over 35 per cent. so that its weight per horse power need not be greater than that of the gasoline engine and probably will be less.

The work was taken up to investigate the characteristic action of fuels used in internal combustion engines with a detailed study of the action of each fuel (gasoline and alcohol) as governed by the many variable conditions of engine manipulation, design and equipment.

These variables were isolated, so far as possible; their separate and combined effects were determined; worked out under practical operating conditions; and lead up to the conditions required for minimum fuel consumption. The results show the saving that can be obtained over conditions for maximum consumption, and also establish a definite basis of comparison under conditions most favorable to each fuel. This latter is a point of much commercial interest and a study of the comparative action of gasoline and alcohol may be of great service in solving some of the general internal-combustion engine problems where other than liquid fuels are used.

THE INSURANCE OF ELECTRICAL MACHINERY.

A DESCRIPTION OF THE ORGANIZATION AND METHODS OF COMPANIES FOR THE INSURANCE OF ELECTRICAL MACHINERY IN GREAT BRITAIN.

William R. Bowker—Cassier's Magazine.

WITHIN recent years the field of companies engaged in boiler and engine accident insurance in Great Britain has been extended to cover electrical machinery, with fairly satisfactory results to the insured and with a considerable financial profit to the companies themselves. The organization and methods of the companies engaged in this business are described in an article by Mr. William R. Bowker in *Cassier's Magazine* for March, from which the following extracts are taken.

The bulk of the business is in the hands of three companies with headquarters in Manchester. At one time these companies suffered severely from competition one with the others but finally an agreement was reached among them which established a uniform rate tariff and eliminated rate cutting. Besides the insurance of electrical plants these firms do an extensive business in the insurance of boilers, engines, gas producers, etc., employers' liability insurance, and consulting and inspection work. Their clients include power users in a great variety of industries and they insure installations of all sizes from the smallest motor drive to the largest central station.

"The three insurance companies mentioned are organized with a board of directors, a chief engineer, who also acts as general manager, a consulting department with a head engineer, assistant engineers and draughtsmen and an agency department (the commercial or business-getting department), at the head of which is the secretary of the company, who also acts as treasurer and paymaster. The insurance department worked in conjunction with the agency department; the inspection department, with a responsible head, who organizes the inspection work, and a record department, dealing with the report records, worked in conjunction with the inspection department. There is a boiler department, whose responsible head and assistant engineers deal with the boiler inspectors' reports on boiler examinations; an engine department, whose responsible head and assistant engineers deal with engine break-downs and inspectors' reports of examinations, and an electrical department, whose chief electrician and assistants deal with breakdowns of electrical machinery and with the outside electrical inspectors' reports on the examination of electrical plants. There is a general typewriting department, in which all the reports to be sent away are written. All the heads of the several departments are held responsible to the chief engineer of the company for the efficient carrying on of their department.

"The outside agents are remunerated upon a salary and commission basis and, in addition, are allowed legitimate expenses. They are supposed not to have any technical knowledge of the practical side of the business, *i. e.*, in regard to hazardous risk or the suitability of the apparatus for insurance, or otherwise. They hunt up a prospective client and, if he is favourably inclined, obtain a signed proposal form at a specified

quoted premium, based upon the size and type of the apparatus, and the premium quoted is determined by the keenness of competition for business.

"After the proposal form is filled up and duly signed by the prospective insurer, it is immediately sent to the head office, and the apparatus or appliance is subjected to a first inspection by a member of the companies' experienced staff of engineers.

"The electrical inspector or surveyor should be a thoroughly experienced and competent engineer, with good technical qualifications, some commercial experience, tact in the handling of clients, and a very essential qualification is the using of sound judgment in reference to the suitability or non-suitability of apparatus for acceptance or rejection by the company. The breakdowns from accident are so frequent that nothing but a first-class risk should be recommended to head office for acceptance.

"The first inspections are the most important duties that the inspector has to undertake, for it is on his sound judgment and ability and his recommendation that the company acts. He should recommend only first-class risks and, at the same time, should be very careful not to refuse business for the company. Many unprofitable clients and very hazardous risks have been recommended and accepted by the companies by giving too much consideration towards the latter element, and the most prudent and safest policy an inspector can adopt is to recommend no machinery or plant to head office for acceptance that he would not personally accept as a safe risk. Then if the company is doubtful about refusing the business, it can send another inspector to accept or refuse the risk.

"First inspections are very important and, in addition to judging the suitability of the risk, the inspector has to take what is called first inspection particulars. This consists in executing rough sketches in a note-book, including plan, elevation and side views of the machine foundation, location of machine in the building, method of securing machine to foundation, sketches of armature, field magnets, brush gear, brushes, insulating rings and many over-all and detail dimensions of the machine and accessories, size of bed-plate foundation, slide rails, bolts (used in construction and fixing), diameter and length of armature and commutator, size of armature shaft, size of commutator wires, how wound, binding wires, number and sizes of other parts, number and depth of commutator segments, field magnet particulars, thickness of insulation, etc.

"After these particulars have been obtained they have to be drafted out and recorded in ink on a four-page sketch sheet of squared, non-destructible parchment paper. This is the company's permanent record of the machine for reference and recognition, and this is kept at head office. The companies are very particular as regards the size of fuse wires they allow for certain sizes of machines, and from a very extensive and valuable experience they strongly recommend the use of copper.

"In addition to first inspections, the inspector has to make periodical examinations of insured electrical plant, which occur three times a year, and are for the purpose of seeing what condition it is in. In these superficial inspections there are many points of vital moment to be looked at, such as sizes of fuse wires, condition of commutators, brushes, brush gear, etc., the presence of oil, dust or grease, the insulation in general, condition of bearings, controlling switches, accessories, etc. These inspections save the companies payment for many breakdowns of a more or less expensive nature, for developing faults are frequently discovered which, if left unattended to or neglected would sooner or later lead to breakdowns of more or less serious moment. . . .

"A report is forwarded to the head office as regards the general condition of machines or plant, any special points of neglect or weakness being recorded, so that the chief engineer can enumerate them in his report to the client, with suggestions and methods of immediate remedying thereof. The machine should be thoroughly examined when both at work and at rest.

"Another important and responsible

feature of the inspector's duties is the immediate visiting of firms where a breakdown has occurred. The damage, cause thereof, etc., are carefully inquired into and, if it is a legitimate breakdown, the inspector recommends head office to accept liability, and the repair is put in hand at earliest convenience.

"If it is a rewinding job (say, on armature or field magnets), the firm who is doing it is visited several times during the repair to see to its satisfactory progress. When machines are located in damp places an insulation resistance test of the armature and field magnets is, or should be, annually conducted.

"These companies do considerable consulting work, advising on power, lighting and equipment schemes, specifications for machines, supervision and testing of materials, etc., and one of the duties of the inspector is to visit manufacturing firms to supervise machines under construction, examine materials used and measure sizes of parts to see if they conform to the specification requirements, and generally see if the assembling and workmanship are of a high order, and, after completion, to make a final visit and be present at the test when machine is on the test bed. Efficiency, brake-horse-power and temperature-rise tests on full-load run for several hours are also carried out."

Tables are given at the end of Mr. Bowkers' article of the premium rates charged by the companies on dynamos, motors, and gas engines. The risks are divided into three classes but the rates established depend not on working conditions but on the conditions of competition. Mr. Bowker says, in conclusion, that the insurance of electrical machinery cannot be placed on a sound financial basis until the conditions of operation are taken into account in fixing rates. "A study of surrounding conditions, as regards location of machines, class of work done, and whether attendant is experienced or otherwise, will generally give a sound basis on which to judge the suitability for insurance and more or less hazardous nature of risk, and this very forcibly suggests and points out that the logical and sound commercial basis upon which to organize and administer an accident insurance business of this kind is by apportioning the premium or rate tariff according to hazard or degree of risk of the machinery or plant under consideration, instead of quoting one set premium for a certain size of machine, irrespective of its working conditions, such as is now adopted by the British companies."

ELECTROLYSIS SURVEYS.

THE GENERAL METHODS OF CONDUCTING SURVEYS FOR THE DETECTION OF STRAY CURRENTS IN GAS AND WATER PIPES.

Albert F. Ganz—American Gas Institute.

THE following brief extracts from a paper by Prof. Albert F. Ganz, read at the last annual convention of the American Gas Institute, give a concise outline of the general methods to be employed in making surveys for the detection of stray currents in pipe lines. Prof. Ganz's paper, which was most comprehensive and contained much detailed information which the limitations of space will not permit us to reproduce, had particular reference to the electrolysis of gas pipes, but the methods he describes are applicable to investigations of water mains as well.

"The first step in making an electrolysis survey of a piping system is to measure potential differences between pipes and rails in a large number of places throughout the system in order to locate these points of current flow between pipes and rails. As gas mains are not generally accessible, service or drip connections are used for making connection with the voltmeter; for this purpose one voltmeter wire is clasped or otherwise fastened to the drip or service connection, care being taken to clean with a file the part where the wire is fastened on so as to insure a good met-

allic contact. The other voltmeter wire is best soldered to a rough flat file which is held on the rail for the contact, and which can be quickly removed and replaced when a car passes. The voltmeter for these measurements should have a high resistance so that an accidental contact at a drip or service connection will not seriously interfere with the measurement. A suitable instrument is a portable high resistance Weston voltmeter with zero center, having ranges of 1.5, 15 and 150 volts. Readings should be taken every 10 seconds for 10 minutes at each point, and the maximum, minimum and average reading noted.

"The average readings are then conveniently marked upon a map showing the principal pipes and tracks, red numbers being used where the pipes are positive to the rails and black or blue numbers where these are negative. An excellent plan is also to plot these potential differences graphically upon a map on which the pipes are shown as lines and using these lines for axes, and the voltmeter readings for ordinates; by shading the areas between the potential curves and the pipe lines with red where the pipe is positive and with black or blue where it is negative to the rails, a clear representation of the potential distribution is obtained. If the negative busbar of the power station is connected to ground plates or to other buried metal as cable sheaths, measurements of potential differences between these and the pipes should also be made and plotted upon a separate map.

"The existence of potential differences betwen pipes and rails, even if large, is, however, no conclusive evidence of stray currents, but indicates at what points current may be flowing from rails to pipes and at what points it may be flowing from pipes to rails or to other return conductors. A high potential difference is in fact usually a sign of a high ground resistance and consequently of but a small current flowing.

"The next step is to determine the direction of the probable current flowing in the pipes. This is done by measuring potential differences between two points in a pipe by means of a millivoltmeter. A convenient instrument for these measurements is a zero center Weston millivoltmeter with two scales, one of 10 and the other of 100 millivolts. These measurements may be made between drips or service connections from 50 to 200 feet apart. These measurements cannot be used, however, for calculating the current strength in the pipes, but only to indicate the probable existence and direction of this current. This direction of flow is then marked upon the map together with the potential readings. . . . . .

"A study of the map will show at what points determinations of current strength should be made. This is done by measuring the drop in potential between two points in the pipe by means of a millivoltmeter, and dividing this by the resistance of the included length of pipe. If this length contains one or more joints this resistance must be measured and not estimated, because joints make contacts of extremely variable resistance. As this resistance measurement is troublesome to make, it is generally more convenient to measure the drop in potential between two points in one continuous length of pipe. With very large pipes and small current this drop is a fraction of a millivolt and requires a specially sensitive millivoltmeter reading to hundredths of a millivolt for its measurement. The resistance of the length of pipe can be calculated from its dimensions and from an assumed figure for the conductivity. . . . . .

"By tracing the flow of currents found in the pipes from these measurements, points can usually be located at which current must be leaving the pipes, and the pipes should be exposed here and examined for evidence of electrolytic corrosion. It must be remembered that all current which is found flowing in a pipe must leave it somewhere in order to return to the negative pole of the generator. This follows from the fact that every electric circuit must be completely closed so that every ampere which leaves the positive pole of the generator must eventually return to the negative pole, no matter how long or

how complicated the path through which it passes may be.

"There may be many other endangered points which these simple tests will not reveal. Stray currents do not always take the simple path from rail to pipe, along the pipe and back to rail or other return conductor, but frequently take roundabout paths, passing from one piping system to another piping system, from this perhaps to a third system or passing across pipes, shunting around high-resistance joints, etc., producing electrolytic corrosion at every point of leaving the pipe for ground. Wherever there are two or more independent piping systems, as for instance water and gas pipes, measurements of potential difference between these should be made to see if any points can be located where current is likely to be passing from one to the other. Current measurements must then be made at these points and plotted and studied as before."

THE ECONOMIC IMPORTANCE OF THE PANAMA CANAL.

THE STRATEGIC POSITION OF THE UNITED STATES AND GREAT BRITAIN IN THE CARRIBBEAN AND THE INFLUENCE OF THE CANAL ON TRADE ROUTES.

Archibald R. Colquhoun—Royal United Service Institute.

THE *Journal of the Royal United Service Institute* for February contains an address by Mr. Archibald R. Colquhoun, presented before the Institute on November 6, 1907, on the strategic and economic effect of the opening of the Panama canal. Mr. Colquhoun prefaces his paper by a short review of the engineering problems connected with the subject. His information as to the present state of affairs seems to be at fault, since he fails to note that the lock type of canal has been finally decided upon and considers that though a temporary lock canal is in course of construction, it will ultimately be converted into a canal of the sea-level type. His comments on the strategic position of the United States and Great Britain in the Caribbean and the influence of the canal on trade routes, however, are interesting and we present them in abstract below.

The strategic value of the canal is recognized by many of the public men of the United States. The growth of Japan as a world power and the awakening of China are phenomena which must be reckoned with and the recent voyage of the American fleet from Atlantic to Pacific home waters has proved a valuable object lesson to the nation generally. The advantage of reducing the distance between the two coast lines by over 9,000 miles and the time of the journey from three months to as many weeks is being generally recognized.

Naturally the United States intends absolutely to control the canal and to that end is strengthening as much as possible her command over the Atlantic approaches to it. A glance at the map will show how powerfully the United States already controls the Caribbean. The three main passages from the Caribbean to the Atlantic lie between Cuba and Haiti, between Haiti and Puerto Rico, and between Puerto Rico and St. Thomas. Cuba is practically American territory, Haiti will be occupied by the United States before long and Puerto Rico is already hers. The third passage mentioned above lies through the Danish West Indies but international influence will keep these islands neutral for a time at least, though both the United States and Germany would no doubt like to obtain them. Of minor alternative routes, the United States controls that between Cuba and the mainland of Florida; the others lie through the group of British islands in the eastern Caribbean. On the mainland surrounding the Caribbean the influence of the United States is supreme, the weak Central American and South American states being almost wholly under her domination.

The position of Jamaica, a strategic point of the greatest potential importance, is the one weak point in the

American control of the Caribbean. The Panama canal is of almost as great importance strategically to Great Britain as to the United States since it offers a line of communication between England and the British possessions in Asia and Australasia alternative to the vulnerable Suez Canal route. There is no reason to doubt that if Great Britain were involved in a war with a European Power the United States would be friendly to her or at least neutral. It is, however, of the highest importance to Great Britain that, without prejudice to American control of the Caribbean, the fullest advantage should be taken of the strategic position of Jamaica, St. Lucia, and the rest of the British West Indies. Most of the British possessions lie outside the American sphere but they exercise an important influence in the Caribbean.

"The strategic and economic effects of a Trans-Isthmian Canal are so intimately interwoven that it is difficult to separate them, but, if we look at it from the point of view of trade routes, we find that Europe is by no means so much affected as the North American continent. The volume of trade between Europe and the East and Australasia will probably continue to go *viâ* Suez, and one result of the competing route may be to lower rates on that canal, and probably will be to widen and deepen it. The long Pacific journey, especially for European Powers not well supplied with coaling stations—a most important consideration—will prove an impediment to the Panama route to the East, and the distance from New York is only slightly in favour of Panama to Australasia, and even to Yokohama. But, when we come to consider trade routes from the Eastern States, and especially those on the Gulf of Mexico, it is a very different matter. Japan and Melbourne are about equidistant by either Panama or Suez, from New York, but the extreme Far East and Australasia represent an immense saving of distance for the States generally by the projected canal. From New Orleans, which will attain great economic importance by the development of the Mississippi and the opening of the canal, the advantage is, of course, correspondingly greater. When we remember the great changes taking place in China and the undoubted increase in the demand of Asia generally for manufactured goods, we cannot doubt that the linking of the oceans will bring a great accession of trade to America generally, and also to Japan, which, as a manufacturing country still possessing cheap labour, will largely benefit by a trade route to the Atlantic seaboard of the United States and (in a lesser degree) the northern coasts of South America. The most striking development, however, and the one which may have the most far-reaching consequences, will be the linking together of the Atlantic and Pacific sea-boards of North and South America. At present Europe competes on practically even terms with North America for the trade of the Pacific slope of the southern continent, but the opening of a short route from New York, and, still more, from New Orleans, to such ports as Callao and Valparaiso, will largely revolutionise the conditions of trade. So far, South America altogether has clung to her connection with Europe, and her ties with that continent are far more intimate than with North America, despite the Monroe doctrine. This state of affairs will not be shaken easily, but the political and commercial pressure which the United States will be able to bring to bear must in the long run have their effect.

"It may be useful at this point to make some mention of an enterprise which has already provided a means of communication across the Isthmus, and owes its existence chiefly to British enterprise. I refer to the Tehuantepec railway, which was opened for traffic at the beginning of this year (1907). This important line crosses the Isthmus through Mexico, and is 189 miles in length and attains a maximum elevation of 735 feet. The terminal points, where magnificent harbours have been made, are Coatzecoalcos, on the Gulf of Mexico, and Salina Cruz on the Pacific. The railway has been built by Messrs. Pearson and Sons, who are partners with the

Mexican Government for the construction, operation, and maintenance of both railway and ports. From first to last the work, which was begun at a time when the canal scheme was in abeyance, has cost some ten millions sterling. The idea of the constructors was not so much to compete with the sea-route *viâ* Cape Horn, as with the trans-continental lines in the United States. This railway has already a great and growing volume of business, though so far it handles only American 'domestic' traffic, viz., that in transportation (in bond) between New York, etc. (on the Atlantic), and San Francisco and Honolulu (on the Pacific). The development of the Mississippi basin opens great possibilities for trade in the Gulf of Mexico, and, despite the trans-shipment difficulty, there is a promising opening for a trans-isthmian line at this point. For the next ten or fifteen years it will have the field to itself, and will build up a traffic which may be a genuine competitor to any lock canal, and a serious rival to the ineffective Panama Railway, though it can hardly hope to stand against a sea-level canal for large vessels from ocean to ocean. The advantage of distance, however, will always be in favour of this route as regards the Eastern and Western States, since it brings New York nearly 1,200, and New Orleans 1,850 miles nearer to San Francisco than they will be by the Panama Canal."

THE INLAND WATERWAYS OF THE UNITED STATES.

THE RECOMMENDATIONS OF THE INLAND WATERWAYS COMMISSION.

Report of the Commission.

ALTHOUGH the report of the Inland Waterways Commission contains no definite plan of waterway improvement, it is in many respects an interesting and important document. The omission of suggestions for the improvement of particular waterways has no doubt caused considerable disappointment but the disabilities under which the Commission labored, its lack of legal status and of funds, and the fact that it was composed of men already burdened with departmental duties in other branches of the public service, were such as to put the extended investigations necessary for the formulation of an intelligent plan of waterway improvement out of the question. The report, however, does an important service in showing how numerous and vital are the interests connected with the question and its first section, devoted to a discussion of the relation which waterway improvement bears to railway transportation, stream pollution, water powers, and irrigation and reclamation works, among other problems of an engineering nature, is worthy of careful study. With this part of the report we have not space to deal but we present below the text of the recommendations of the Commission as to how the work of investigation and improvement should be carried on and administered.

"A. We recommend that hereafter plans for the improvement of navigation in inland waterways, or for any use of these waterways in connection with interstate commerce, shall take account of the purification of the waters, the development of power, the control of floods, the reclamation of lands by irrigation and drainage, and all other uses of the waters or benefits to be derived from their control.

"B. We recommend that hereafter both local and general benefits to the people shall be fully considered in any such plans for the improvement of navigation in inland waterways, or for any use of these waterways in connection with interstate commerce; and that wherever practicable Federal agencies shall cooperate with States, municipalities, communities, corporations, and individuals with a view to an equitable distribution of costs and benefits.

"C. We recommend that hereafter any plans for the navigation or other use of inland waterways in connection with interstate commerce shall take full account of transfer facilities and sites,

and of the location of tracks, grades, bridges, dams, depots, and other works on navigable and source streams with a view to equitable co-operation between waterway and railway facilities for the promotion of commerce and the benefit of the people.

"D. We recommend that any plans for improving the inland waterways shall take account of the present and prospective relation of rail lines to such waterways, and shall ascertain so far as may be whether such waterways when improved will be effectively used in the face of railway competition; and that the relations between railways and waterways be further examined with the purpose of devising means of rendering the two systems complementary and harmonious and making such fair division of traffic that rates and management may be co-ordinated economically and with benefit to the country.

"E. We recommend that the adoption of means for ascertaining regularly all facts related to traffic on the inland waterways, and for publishing the same in a form suitable for general use.

"F. We recommend the adoption of means for ascertaining and rendering available, at such rate as to meet public necessities, all requisite data related to the physical character and general utility of the navigable and source streams of the country.

"G. We recommend that hereafter any plans for the use of inland waterways in connection with interstate commerce shall regard the streams of the country as an asset of the people, shall take full account of the conservation of all resources connected with running waters, and shall look to the protection of these resources from monopoly and to their administration in the interests of the people.

"H. We recommend that the Congress be asked to make suitable provision for improving the inland waterways of the United States at a rate commensurate with the needs of the people as determined by competent authority; and we suggest that such provision meet these requisites, viz., expert framing of a definite policy; certainty of continuity and co-ordination of plan and work; expert initiative in the choice of projects and the succession of works; freedom in selection of projects in accordance with terms of co-operation; and the widest opportunity for applying modern business methods.

"I. We recommend that the Congress be asked to authorize the co-ordination and proper development of existing public services connected with waterways; and we suggest that such enactment might provide that the President of the United States be authorized, with the advice and consent of the Senate, to appoint and organize a National Waterways Commission to bring into co-ordination the Corps of Engineers of the Army, the Bureau of Soils, the Forest Service, the Bureau of Corporations, the Reclamation Service, and other branches of the public service in so far as their work relates to inland waterways, and that he be authorized to make such details and require such duties from these branches of the public service in connection with navigable and source streams as are not inconsistent with law; the said Commission to continue the investigation of all questions relating to the development and improvement and utilization of the inland waterways of the country and the conservation of its natural resources related thereto, and to consider and co-ordinate therewith all matters of irrigation, swamp and overflow land reclamation, clarification and purification of streams, prevention of soil-waste, utilization of water-power, preservation and extension of forests, regulation of flow and control of floods, transfer facilities and sites and the regulation and control thereof, and the relations between waterways and railways; and that the Commission be empowered to frame and recommend plans for developing the waterways and utilizing the waters, and as authorized by Congress to carry out the same, through established agencies when such are available, in co-operation with States, municipalities, communities, corporations, and individuals, in such manner as to secure an equitable distribution of costs and benefits."

A RAILWAY IN GERMAN EAST AFRICA.

DETAILS OF THE RECENTLY OPENED DARESSALAM-MOROGORO LINE.

Herr Schubert—Glasers Annalen.

AN interesting general survey of the activity and progress in railway building in the Dark Continent was given by Mr. J. Hartley Knight in THE ENGINEERING MAGAZINE for January, 1908. The purpose of the following review is to give a few of the more important details of the railway in German East Africa from Daressalam to Morogoro, to which Mr. Knight gave only a passing notice, after a paper by Herr Schubert, published in *Glasers Annalen* for February 1.

The Daressalam-Morogoro railway was originally conceived as the beginning of a Central African railway which should be extended to Kilossa, Mpapua, Kilimatinde and Tabora, and ultimately reach Udjidji. In 1895 the Colonial Administration joined with the German Bank and the German East African Company to carry out, under the direction of a committee established for the purpose, the preliminary explorations for a railway from the coast to Udjidji in the heart of the lake country. The preliminary work was begun immediately and in 1896 a project was put forward for a 75-centimetre gauge line to Morogoro which was to form the first section of the larger work. Further developments, however, were disappointing and it was not until July, 1904, that a statute providing for the construction of a metre-gauge line from Daressalam to Morogoro was passed. The Imperial Government undertook to guarantee the interest at 3 per cent. on a capital of 21 million marks and also guaranteed the repayment of the capital originally invested in the company at 120 per cent. of the par value of the shares. The East African Railway Company was organized on this basis and was given special land and mineral rights. The Imperial Government is given a share of the profits of the company and at the end of 88 years the road reverts to the Government free from debt and without compensation.

According to the statute the gauge of the road was to be 1 metre. The maximum grade allowable was limited to 3 per cent. but if possible grades were to be limited to 2½ per cent. As a rule curves of not less than 100 metres radius were to be chosen; only when curves of this radius could not be obtained without great difficulty and expense was the use of a smaller radius, limited to 60 metres, permissible. The width of the embankment was to be at least 3.5 metres in the open stretches. The track was to be designed to carry safely a concentrated wheel load of 4 tons moving at the rate of 40 kilometres per hour. The rails were to be able to carry a moving wheel load of 4½ tons when carried on steel ties spaced 75 centimetres, centre to centre. Screened gravel or broken stone was to be used for ballast.

The first line projected for the Morogoro line passed to the north of the Pugu Mountains and contemplated the establishment of a branch to Bagamojo. The importance of the latter port in the trade with Zanzibar is even greater than that of Daressalam but Daressalam was chosen as the starting point of the Central African Railway on account of its superior dock and harbor accommodations. The second projected line passed to the south of the Pugu Mountains. The length of the first line was 257 kilometres, exclusive of the Bagamojo branch. The second line reduced this to 220 kilometres. The latter line crossed the passes of the Pugu Mountains at elevations of 244 and 260 metres, dropping between these two points to an elevation 56 metres below that of the lower pass.

Notwithstanding the opposition of various persons familiar with the country, the engineers in charge of the exploratory work persisted in seeking a shorter line through the Pugu Mountains by way of the Msimbasi valley. They were rewarded in 1903 by finding the route finally adopted, which short-

ened the Daressalam-Morogoro line to 209 kilometres. The line follows the Msimbasi valley closely to the Pugu Mountains, and crosses the passes of the latter at elevations of 194.45 and 195.90 metres, dropping between these two points only 44.45 metres. The total saving of elevation over the more southerly line amounts to 125.15 metres. Between the two passes of the Pugus the line crosses the Mpiji river and after crossing the second ridge it falls by repeated short grades to the Ruvu river which runs through a valley about 4 kilometres wide. Over this depression the road is carried on an embankment and a bridge 488 metres long. From this point the line gradually rises, crosses the Ngerengere on three short bridges and winds along the Lukonde through the foothills of the Uluguru Mountains to Morogoro, reaching at the terminal an elevation of about 497 metres.

Remarkable progress has been made in the construction of the road. Herr Schubert gives a very interesting description of the engineering problems which had to be solved, which we have not space to record. It must be mentioned, however, in conclusion, that on October 9, 1907, a passenger train ran over the whole length of the line and that its opening for regular traffic may be expected in the near future.

THE PROBLEMS OF ROAD CONSTRUCTION.

A DISCUSSION OF THE RELATION BETWEEN ROAD AND WHEEL, AND A NEW METHOD IN MACADAM ROAD CONSTRUCTION.

H. S. Hele-Shaw and Douglas Mackenzie—Royal Society of Arts.

THE problems of road construction as they exist at present in England are very much altered from those of a few years ago. So long as the roads were used only by comparatively slow, horse-drawn vehicles with moderate axle loads, they could be kept in fairly good condition for a considerable traffic, even when of comparatively inferior construction. The phenomenal development of motor traffic, however, has changed these conditions, and the effect of the change is to be seen in the large increases in the expenditures for road construction and maintenance with which the municipalities are burdened. The problems confronting municipal engineers are of a very difficult nature, for, though the limit of possible taxation in the country districts has been almost reached, the conditions responsible for the increased cost of road maintenance have by no means reached a state of finality and the probable rapid development of heavy motor traffic in the near future is likely to present difficulties of even greater magnitude than those which exist at present. The problems of road construction with a view to modern and future requirements were the subject of an interesting paper by H. S. Hele-Shaw and Douglas Mackenzie, read before the Royal Society of Arts on February 26, which is abstracted below. The authors devote their attention to a discussion of the best engineering construction to secure the most efficient road at the lowest cost and their paper contains many suggestions of universal interest.

The only sound way in which the problems of construction may be approached is to consider the road as one element of a mechanical contrivance of which the wheel is the other element. The end for which these two elements are designed is that they may run smoothly and in contact with each other, resisting considerable mutual pressures without permanent deformation and without undue wear or loss of energy. The ideal condition would be, obviously, to have a perfectly hard and circular wheel running on a perfectly hard and level road and a steel wheel and a steel road might seem as suitable for common roads as they are for railway practice. Apart from the question of cost, however, the metal road would not possess the qualities of adhesion necessary in highways. Though a really hard road is not practicable, it is reasonable to sup-

pose that, if a moderately hard road could be kept level and free from unevenness of surface, the cheap and durable, circular metal wheel would be universally employed as the most satisfactory.

"But a thing so desirable as a truly level surface is exactly what it is impossible to maintain, and it is in order to mitigate the shocks caused by the tendency to deflect a vehicle from its movement in the straight course, that yielding material such as solid rubber or pneumatic tyres are employed on the periphery of a wheel. Now we cannot employ this soft material without paying the penalty, not merely of wearing the wheel but of wearing the road itself, and as a matter of fact in so much as the contact between the wheel and the road departs from a point in the side elevation, or a line looked at in plan, by so much is wear between the surfaces in contact introduced. In the next place let us consider what goes on beneath the surface. If the road is not hard, then a certain amount of deformation must take place.

"The injury done by this deformation will depend on two things:—

(1) The depth to which it will extend (*i. e.*, magnitude of deformation).

(2) The extent of permanent disintegration of the internal substance of the road.

"It is obvious from the foregoing remarks that both as far as the surface is concerned, and also the body of the road, what is required is a tough elastic material, or if on the score of expense it is impossible to have such a material for the whole road, then the material of which the road is actually composed should be cemented or bound together by such a material.

"In any case as the road is exposed to the action of the weather one of the very first conditions of its efficiency is that it must be waterproof, and that the surface must be sufficiently hard to prevent as much as possible the formation of liquid material—let us call it mud—in wet weather, and loose, finely-divided particles—let us say dust—in dry weather. . . . . Not only is a waterproof road with a tough and durable surface valuable because it prevents the formation of dust and mud, but for the even more important reason that a dustless road is necessarily a waterproof one, and if the interstices are filled with some tough material, the bodily destruction of the road is to a great extent prevented, and the road becomes an ideal one."

Of the three types of road in common use, asphalt, wood and stone, the two first more nearly fulfil the requirements of a perfect road than the last but their cost is prohibitive for anything but town use. Stone roads are of two types, paved and macadam. The paved road, when once laid down, lasts for many years with but small maintenance charges and is fairly satisfactory when a level surface is not required. It is totally unsuited, however, for motor traffic and especially heavy motor traffic which demands a much smoother road than will serve when the traffic is slow and horse-drawn.

In the construction of a good macadam road three conditions must be fulfilled, namely, first, that the road must be of as hard a stone as can be obtained at a reasonable cost; second, the spaces between the stone must be filled with a material of as nearly the same nature as the stone itself; and third, the whole road crust must be consolidated with some binding material. The sprinkling of roads with crude oil, which seemed at first a fairly successful expedient for dust prevention and waterproofing, has been practically abandoned because the oil does not bind the material with sufficient tenacity to resist really heavy traffic. Sprinkling with tar has marked a great advance but the results are very contradictory. In some cases very good results have been obtained, the tar being absorbed by the mud between the stones and forming a compact tenacious binding material; but in others the tar has been prevented by some injurious cause from penetrating into the substance of the road and it has merely formed a carpet on the surface, liquid in summer and brittle in winter. In these unsuccessful attempts the black slime formed by the

tar has been most objectionable. The great difficulty in the use of tar lies in the changes it shows at different temperatures. Many investigations have been made on the treatment of tar to produce a resultant material of a more suitable nature and a number of satisfactory materials have been produced. The high first cost of roads on which these materials are used has, however, militated against their general adoption.

"It has been left to the surveyor of one of our rural districts, Mr. A. Gladwell, to prove that a dustless road need cost but a very small amount more than the old waterbound roads by applying the binding material in a novel manner. He uses a suitable tar preparation to make a matrix of fine granite chippings mixed in this tar preparation. He lays this matrix on the old surface of the worn road to a depth of ½ to ¾ inch. He then spreads the broken road stone on the top of this to a thickness not exceeding 4 inches, and rolls it immediately with a steam-roller. The roller forces the stone down into the matrix, and squeezes up the matrix into the interstices, and, if they have been laid in the right proportion, a little rolling will bring the matrix almost up to the surface. A small quantity of matrix can now be laid over the surface, and brushed in, and a final rolling will produce a thoroughly waterproof surface. The cost of this system need not exceed 2½ pence per superficial yard above the cost of a similar coating of granite on the old waterbound system, and it is known that it will last twice as long, and with more favourable conditions, possibly from three, five, to even seven times as long. Mr. Gladwell has thus produced a system of road construction that is applicable to all the roads of this country, and will enable surveyors to use local material, if it is not of too soft a nature, and to produce roads that will be unaffected by the temperature or by the weather, and strong enough to carry anything in reason that may be put upon them. At the same time, the stones will be securely held in position, and there will be no dry mud to be sucked out of the interstices by the pneumatic tyres of motor-cars. It looks as if the destruction of the roads by motor-cars can thus be completely obviated, and almost the only source of wear to this kind of road surface will be the attrition of horse-shoes and the steel tyres of horse-drawn vehicles. The rolling contact made by self-propelled traffic on rubber tyres seems likely to produce little appreciable wear or injury to such surfaces, and its waterproof nature saves any necessity for scraping or scavenging other than that which nature supplies by occasional heavy rain storms.

"Having devoted considerable space to the road, something must be said about the other element working in conjunction with it, namely, the wheel. Restrictions have very properly been devised and are enforced by law with a view of protecting the roads from undue destruction by wheels; but it is clear that just as there are demands made for road improvement on the one hand, so will demands be made and vigorously voiced for further restrictions in the matter of wheels on the other. The use of studded tyres is a case in point, and the authors think that, concerning their use, road surveyors have a just grievance at the present time. A new studded tyre with projecting steel studs and rotated by an engine of 40 to 60 horse-power, is capable, in passing along the road, especially in climbing hills at a high rate of speed, of doing a considerable amount of damage to the surface of a road, and when scores, if not hundreds, of such tyres pass along one piece of road in a day, it is obvious that there is no road surface, unless made of steel itself, that would not be cut to pieces in a short time by such means.

"With regard to the types of heavy commercial vehicles, it is certain that unless the diameter of their wheels is increased, they will form, as this class of traffic increases in future, a very serious problem to the road constructor. It is astonishing how much the injury to a road surface is reduced by the comparatively small increase in the size of wheels of steam tractors, which only average about 4 feet 6 inches in diameter, as against 3 feet 6 inches of a heavy

motor vehicle. Of course, even better comparative results are obtained with the much larger wheels of the heavy traction engine, and the authors do not think it is going too far to say that if the wheels of such traction engines were not of the size they are, the passage of one such traction engine on a road, in certain states of the weather, drawing of course its full load, would be sufficient to do incalculable damage, that is, assuming it were able to pull its load at all. The authors do not wish to enter farther into the question of the wheel. They have drawn attention to some of the chief points which are of pressing importance in the matter of road construction, and wish, in conclusion, to remark that while they have shown that there must be sympathetic co-operation between the designer of the wheels of a motor vehicle, and the surveyor who is responsible for the maintenance of the road, there is a third party, who has a serious responsibility in the matter, namely, the user of the road.

"However good the road, and, however well designed are the wheels, a great responsibility must rest with the driver of a motor vehicle. By the incessant use of the crown of the road, leading to tracking, by the injudicious use of brakes, by the rushing of corners at unreasonable speeds, and in many other ways, the driver of a motor vehicle can do more damage in a week to the roads, as well as to the vehicle he is responsible for, than would be otherwise the result of twelve months fair usage. The authors trust they have shown that if the drivers and manufacturers do their part, the science of road construction has now advanced sufficiently for the road surveyor to be able to do his part without putting an undue and even prohibitive burden upon the community."

AN ACID-RESISTING ALLOY.

A RECORD OF RECENT ADVANCES IN APPLIANCES FOR THE MANUFACTURE AND CONCENTRATION OF ACIDS.

A. Jouve—Société des Ingénieurs Civils de France.

ACCORDING to a paper by M. A. Jouve, presented at a recent meeting of the *Société des Ingénieurs Civils de France,* the chemical industry is to benefit materially by recent advances in the study of alloys of iron and silicon. The great difficulty in that branch of the chemical industry which is concerned with the manufacture and concentration of acids has been the lack of a satisfactory material for the construction of the vessels in which these processes are carried on. The function of acids in their industrial applications is to attack and dissolve materials, but the same property which makes them of industrial value renders their manufacture a difficult and expensive operation. Recent investigations, of which the following abstract of M. Jouve's paper gives a brief outline, have found in certain metallic compounds in which iron and silicon are the predominating elements, a combination of properties which enables them wholly to remove the most troublesome and costly features of acid manufacture

To illustrate the importance of the discovery, M. Jouve takes the case of the concentration of sulphuric acid, in which, he says, the difficulties are typical of all acid processes. A variety of materials is used for the vessels in which the concentration process is carried on but all of them possess serious disadvantages. From the point of view of resistance to the action of acids, glass and porcelain, which are largely used, give every satisfaction. These materials are made into evaporators or retorts which are directly exposed to the fire or are protected by a cast iron covering which, in case of breakage, receives the acid and prevents its entrance into the furnace. Besides their fragility which renders them liable to breakage under sudden changes of temperature, these appliances have the great inconvenience of being very limited in size. When their diameter exceeds 40 centimetres

the cost of manufacture is very high and most works find it necessary to be satisfied with the inconvenient arrangement of a very large battery of small vessels. Stoneware is cheaper than glass or porcelain but has the same disadvantage of being liable to breakage, with consequent loss of material. Breakage is very hard to prevent, even by making the vessels very thick, since hot acid seems to produce a peculiar molecular disintegration in addition to a slight chemical action. Alloys of platinum and iridium or platinum and gold and combinations of platinum with iron or lead are widely used but their cost is very high and the consumption of the platinum by the acid increases rapidly with the degree of concentration. Lead is attacked only slightly by acid at 50 to 52 degrees Beaumé but cannot be used for concentration above 60 degrees. The final concentration has to be made in porcelain or platinum vessels. Iron, on the other hand, is attacked by dilute acid but only slightly by concentrated. Among minor materials may be mentioned silica which is very satisfactory so far as its resistance to acid is concerned but the appliances made from it are limited in size. For the larger sizes, above 30 to 40 centimetres in diameter, the price is prohibitive.

To sum up, therefore, none of the ordinary materials in use will permit an uninterrupted concentration of sulphuric acid to 66 degrees Beaumé in one vessel, except glass, porcelain or silica, and the use of these is attended by the disadvantages enumerated above. Since 1900 researches have been carried on to discover a satisfactory material but practical success was attained only last year. The researches were based on a laboratory observation, that of the difficulty of dissolving in acid the iron-silicon alloys, and the practical impossibility when they contain over a certain percentage of silicon. The acid-resisting properties of these alloys immediately suggested their utilization for the construction of appliances for acid manufacture but their other properties presented great difficulties in the practical solution of the problem. The aims of the investigators were to produce at a moderate price a metal or metallic compound which no acid would attack and which could be cast in any desired form, and to give it such mechanical properties that it would resist a considerable amount of stress, either tension or compression, and shock.

The alloys experimented with were complex metallic silicides of high silicon content, in which the silicides of iron formed the principal part of the mixture. It was found that the percentage of silicon had to be varied according to the purpose for which the material was intended. No fixed rule can be laid down as to the amount of silicon necessary to produce a compound satisfactory for all purposes but each case presents a problem in itself. Though all chemists who have analysed iron-silicon alloys will agree that these substances, even when pulverized, are absolutely unattacked by even the strongest acids, it was found in these investigations that alloys containing as much as 65 per cent. of silicon are attacked to a certain extent under the conditions met in industry, an anomaly which can be explained only by the influence of temperature and mass The difficulty met with here was the one usually encountered in applying a laboratory process to industry and a large amount of experimenting was necessary before success was finally attained.

After a compound with the necessary acid-resisting qualities had been produced, great difficulties were met in giving it the required form, especially when dealing with considerable masses of the material. The difficulties of handling ferro-silicon are well known to metallurgists. The commercial article containing about 20 to 25 per cent, of silicon can be melted, though with difficulty, but it is almost impossible to cast it, the molten metal having a drossy appearance and moulding badly. Even when the casting is successfully accomplished, when the mould is carefully dried and every precaution is taken to cool the casting slowly, the piece will be found broken or at least badly cracked when the mould is broken up. This is due to the fact that compounds of iron and silicon are not, properly speaking, alloys,

but binary combinations of a metal, iron, with a metalloid, silicon, and the shrinkage differences are so great as to cause cracking even at red heat.

This difficulty was overcome by the addition of certain other substances to the compound of iron and silicon. The ferro-silicon used is prepared in an electric furnace and before it leaves the furnace all impurities are eliminated, suitable reagents being employed to render them volatile. The materials which make it possible to cast the compound are added in the casting ladle. M. Jouve does not say what these materials are. They vary, he says, according to the purpose for which the casting is to be used and as yet they must remain a trade secret. Their use, however, produces a metal which is very hot and absolutely fluid and which moulds perfectly. The resulting castings fulfil all the requirements of acid manufacture.

These materials are already applied extensively to the processes of the concentration of sulphuric acid and the condensation of vapors of nitric acid, both in France and abroad, and they are also being used for the construction of fans for handling corrosive gases, pumps for acid waters, and in other ways. M. Jouve concludes with a comment on the entire success which has attended their use for the concentration of sulphuric acid. In concentrating directly from 50 to 66 degrees Beaumé the vessels were absolutely unattacked except for a slight, temporary, surface scouring, due to the slight modification of the alloy by its contact with the moulding sand.

REFRACTORY MATERIALS.

A DISCUSSION OF THE APPLICATION OF THE LAWS OF PHYSICAL CHEMISTRY TO THE ESTIMATION OF THEIR EFFICIENCY.

Thos. Holgate—Engineering.

ONE of the most remarkable features in the close relation between pure science and modern engineering is the extent to which the laws of physical chemistry have been applied to the explanation of phenomena met in every day practice, the causes of which have long been obscure. The usefulness of these laws is not confined to any one branch of physical or natural science nor to any one branch of industry but it is perhaps most striking in the engineering side of chemistry and metallurgy, where prominent examples are to be found in the explanation of the corrosion of steel, mentioned in this department in the April issue of THE ENGINEERING MAGAZINE, and the formation and heat treatment of alloys. In *Engineering* for February 21, 1908, Mr. Thos. Holgate gives an interesting discussion, abstracted below, of the application of these laws to the elucidation of another complex question of metallurgical interest, namely, the nature of materials in their refractoriness to heat.

The problem is one of the utmost importance economically. In the manufacture of iron and steel and all other high-temperature operations, the cost of renewal of fire-clay materials is a large item. Further, the output of a set of furnaces over a given period of time is dependent largely on the life of the brickwork. The urgency of the question has been shown from time to time but the discussions of technical societies have had little or no effect in remedying the prevailing lack of knowledge of even practical technical men, both makers and users. Up to a few years ago very few makers could state with precision the amount of heat their products could stand. The engineer was further handicapped by the fact that a chemical analysis of the finished product not only is very difficult to make but, unless complete and accurate, may be misleading. A certain amount of general knowledge has been current among skilled technicians as to the effects of certain constituents of fire-brick on their life and efficiency but what was long lacking was a co-ordination of the knowledge of the maker, the chemist and the user that should show with some degree of con-

sistency why various constituents should act as they do and what their relation to one another in increasing fusibility.

The acquisition of this knowledge has been made possible by the formulation of the physico-chemical laws relation to solid solutions and their behavior, notably the law of the depression of the freezing point. Mr. Holgate mentions as examples of the ways in which these laws have been applied to explain the complex phenomena of refractory materials, the invention of Seger's cones and the investigations of Prof. Vogt on iron blast-furnace slags. He concludes with a discussion of their application to the solution of the problems which arise in ordinary practice.

"The usual method of finding out the value of a firebrick is to expose it to heat under conditions as nearly alike as possible to those under which the bulk will be used, and after this preliminary, if found satisfactory, it is used in succession on the small, medium, and large industrial scale. Only after such prolonged trial is its quality assessed, and a further precaution is taken to have made an analysis of a sample of the bricks thus found satisfactory. The analysis so obtained is employed as a check upon the future deliveries of so-called similar bricks, used under similar conditions. Such a method occupies a long time, and may be costly, and is always accompanied by uncertainties such that no responsible man cares to be compelled to repeat it more than is absolutely necessary. It is, however, the ultimate test to which any newly-proposed brick must be submitted; for whilst there may be much other evidence, it can be only regarded as collateral, and cannot be accepted as a substitute for the succession of tests—or, in other words, the practical experience. What other information can do, therefore, is to enable one to say whether a certain composition, as revealed by analysis, is at all likely to be worthy of testing upon the working scale, and to connote more explicitly the observed behaviour in relation to the chemical composition and the conditions under which the material has been proved. For the value of a fire-brick for a given purpose is made up of many factors. Not only must it resist a high temperature, but in many cases it must do this when in contact with gases or with molten liquids, slags, or ashes of fuels that enter into combination with the firebrick as a whole or with its separate parts. Again, a brick may be required of special composition or compactness, to resist the action of a low temperature coupled with the action of gases or slags. These practical considerations of the sum total of causes and effects, when fully realised, point in the same direction as those derived from the investigations of physicists and chemists when examining each influence singly. They show that the chemical composition in relation to temperature and to liquid and gaseous surroundings must, firstly, be such as to limit combination between the two; and, secondly, such as to reduce to the minimum the chance of combination among the components of the brick. Should there be bases (metallic oxides) present, they should be those that do not readily combine with the principal acid constituent — silica. The alkalies, potash and soda, are pre-eminently those that combine at the lowest temperature with silica, and may form a softening mixture which behaves like a matrix for a solid solution. That once formed, there begins the effect of the 'depression of the melting-point of the compound,' by the solution in the matrix or solvent, of the various other oxides present, or it may be of other acids, such as titanic acid, for example. The way in which these oxides and acids act to increase fusibility—that is, in other words, to depress the freezing-point—has been found to be in the ratio, not of their percentages by weight, but in the ratio of that percentage divided by the molecular weight of the substance dissolved. In this way it is clearly explained why, for a given weight of iron in a fire-clay, it has double the effect in increasing fusibility when in the state of ferrous oxide to what it has when in the state of ferric oxide. The important question of the relation of silica to alumina is worthy of lengthened consideration here; but the more striking results exemplified by

the constituents usually regarded as responsible for increase of fusibility must suffice. The conclusions of Herr Ludwig, of the Chemical Laboratory für Thon-Industrie, Berlin, concisely expressed as follows, sum up the case most clearly:—'It is impossible to judge of the character of a clay by merely adding together the quantities of the impurities it contains. It must be considered molecularly.' Herr Ludwig analysed eighty-five clays, and compared their theoretical melting-points, deduced from their molecular proportions, with the actual temperatures of fusion as shown by heating alongside Seger cones. In the majority of cases there was close, and in the others reasonable, agreement."

THE POSSIBILITIES OF ELECTRIC SMELTING.

A DISCUSSION OF THE ECONOMICAL POSSIBILITIES OF THE ELECTRO-THERMIC PROCESS FOR THE PRODUCTION OF PIG IRON AND STEEL.

A. Stansfield—Canadian Mining Institute.

THE following abstract of a paper by Dr. A. Stansfield, read at the recent annual meeting of the Canadian Mining Institute, presents an interesting review of the present development and future possibilities of the electrical process for the smelting of iron ores. As yet the electric furnace has proved a commercial success only in the production of crucible cast steel but its technical success in the direct smelting of ore has amply demonstrated that, in certain localities and under certain conditions at least, it will be able successfully to compete with the blast furnace at no very distant date. Dr. Stansfields' paper gives a very clear view of what can probably be accomplished in this direction, the manner in which the successful results can be obtained, and the advantages and drawbacks of the electrical process.

"Electrical energy has recently been employed to replace, in certain operations, the heat which is ordinarily obtained by burning fuel. Electrical energy is somewhat expensive, and it was naturally employed at first for the production of the more valuable products, such as crucible steel, where the cost is of less importance. The electrical production of cast steel for tools and similar purposes may be accomplished in two ways—(1) by melting down pure varieties of iron and steel with suitable additions of carbon and other ingredients, just as in the crucible process, but using electrical energy for heating instead of coke or gas; (2) by melting a mixture of pig-iron and scrap steel as in the open-hearth process, and removing the impurities, such as sulphur and phosphorus so thoroughly by repeated washing with basic slags that a pure molten iron is at last obtained. This can then be recarburized and poured into moulds. Both of these methods are now employed commercially for the production of good qualities of tool steel. The larger sizes of electrical furnace that have already been constructed hold 5 or 10 tons, while the crucible will hold only about 80 pounds, and the high efficiency of the electrical method of heating more than compensates for the greater initial cost of electrical energy as compared with heat derived from fuel. The resulting steel is found to be even better than crucible steel, and can be produced at less cost. It is, therefore, only a question of time until the crucible process shall be entirely replaced by the electrical process in all localities where electrical energy can be produced at a moderate figure."

Two types of furnace have been used for making cast steel, the Héroult and the induction furnace. The former is essentially an open hearth furnace in which the heat is produced by electric arcs maintained between the molten slag and two carbon electrodes which hang through the roof. It has been found very suitable for the refining of mixtures of pig iron and scrap steel for the production of crucible steel. The induction furnace is better suited to the simple melting of pure iron for carburisa-

tion, as in the crucible process, than to refining. In this furnace no electrodes are used. It consists of an annular trough containing the steel, which acts as the secondary of an alternating-current transformer. An alternating current supplied to a primary winding induces a very high current in the secondary, the ring of steel, and enough heat is produced to melt the steel. This type of furnace has lately been constructed in sizes with a capacity of 8 tons of steel and consuming 1,000 electrical horse power. In both types of furnace the consumption of energy is about 800 to 900 kilowatt-hours per ton of steel when cold stock is used, or 600 to 700 kilowatt-hours per ton using melted pig iron. The cost is higher than that of the open hearth process but a vastly superior steel is produced.

In direct smelting in the electric furnace carbonaceous fuel is used in the charge only to eliminate the oxygen of the ore, and its amount can be regulated so that the furnace will yield either pure iron, steel or pig iron at will. Certain difficulties in the steel process, however, have prevented it from being as far developed as the process for the production of pig iron, which has advanced satisfactorily under the work of Héroult, Keller and others. In his latest experiments, those at Sault Ste. Marie, Héroult used a furnace consisting of a vertical shaft, similar to a small blast furnace. One carbon electrode was suspended in this shaft and the other was formed by the carbon lining of the furnace crucible. The ore, fluxes and the necessary carbon was fed down the shaft, around the vertical electrode, and the heat produced by the current was sufficient to carry out the chemical reactions involved in the reduction of the ore and the fusion of the pig iron and slag. The Keller furnace is the same in principle as the Héroult but consists of two vertical shafts, each containing a suspended vertical electrode, connected by a trough to permit the passage of the current from one shaft to the other and for the collection of the molten iron and slag. Furnaces of this type consume about 0.3 horse-power year of electrical energy and 800 to 900 pounds of coke per long ton of pig iron produced. Assuming the general costs of operation of the electric and blast furnaces to be equal, these figures would indicate that the electric furnace would need to obtain energy at a cost per horse-power year of less than that of two tons of coke in order to compete with the blast furnace. When it is taken into consideration that the heating value of one electrical horse-power year is about the same as that of three-quarters of a ton of good coke, it is obvious that the electric furnace, even in its present state of development, is much more economical of heat than the blast furnace.

The electric furnace possesses certain advantages over the blast furnace which may in some cases outweigh the disadvantage of the high cost of electrical energy. Owing to the absence of a blast, sandy or powdery ores which cause so much trouble in blast furnace operation can be smelted without difficulty. Another advantage is in regard to the smelting of titaniferous or other difficultly fusible ores, which the high temperature of the electric furnace accomplishes with ease. The high temperature is advantageous also in the treatment of high-sulphur ores, since it enables a larger proportion of lime to be used in the charge and even more strongly reducing conditions to be obtained in the furnace. A final point in favor of the electric furnace is that it does not require a high quality of coke for fuel but will operate successfully with carbon in any form. Coke or charcoal is used only as a chemical reagent and the physicai qualities of the fuel have no effect on the operation of the furnace.

Commercially, however, the electric furnace has many difficulties to overcome, one of the most important being the small scale on which it has been constructed so far. In the Héroult furnace the height of the shaft is limited by the length of the electrode, though in an improved furnace designed by Haanel and Turnbull a greater height of ore column was obtained by a system of inclined shafts. Another weak point in the construction of the electric furnace is that

no provision has been made for utilizing the heat of the waste gases. Turnbull has proposed for the furnace mentioned above the addition of a rotating tube furnace through which the ore may pass on its way to the electric furnace and be preheated by the burning of the waste gases.

"In view of the importance of reducing the consumption of fuel and electrical energy to the lowest possible point, the writer has calculated what could be expected in this way if the gases arising from the reaction between the charcoal and the ore were used partly for the reduction of the ore and partly for preheating the ore. Such a result could be attained in a furnace consisting essentially of three parts. In the upper part the otherwise waste gases are burned by air introduced there and communicate their heat to the incoming ore to which the fluxes but not the charcoal have been added. In the middle portion of the furnace the gases arising from the lowest portion, which may be considered to be wholly carbon monoxide, react on the heated ferric oxide, if that were the variety of ore to be treated, and reduces it to ferrous oxide. The charcoal is introduced in the lowest section of the furnace and completes the reduction of the ore to metal. Electrical energy is introduced into this section of the furnace and serves to melt the resulting pig-iron and slag, and to supply the heat necessary for the preceding chemical reactions. The details of the construction of such a furnace have not been worked out at present. In a furnace of this kind it can be calculated that one ton of pig-iron can be obtained from an average ore by the use of 0.2 horse-power years of electrical energy and about 600 to 800 pounds of coke or good charcoal. This includes a reasonable allowance for loss of heat. A further allowance should be made for irregularity in the use of the electrical power and, taking this into account, we may consider that one-quarter of a horse-power year and 600 to 800 pounds of coke or charcoal would be required for reducing one long ton of pig-iron from the ore.

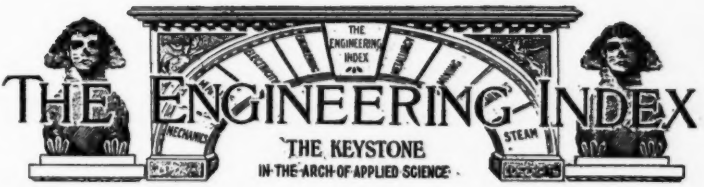
"Considering these figures, it will be seen that the use of ¼ electrical horse-power year will save about 2/3 of a ton of coke, or that 1 electrical horse-power year should not cost more than 2 2/3 tons of coke if the electric furnace is to compete with the blast-furnace. Thus an electrical horse-power year at $12.00 would correspond to coke at $4.50 a ton. The considerations previously mentioned in regard to the use of cheaper fuel and cheaper ore in the electric furnace would also apply in this case, and with improved design and construction the size of the electric furnace may be increased so as to admit of a large and economical output of pig iron."

No economical scheme for the direct reduction of steel from the ore has ever been put into operation on a large scale. Both Stassano and Héroult have been successful in producing steel but they abandoned the process as uneconomical. Among the difficulties of the problem may be mentioned as most important:

"1. The difficulty of eliminating sulphur when this is present in the ore, the blast-furnace producing pig-iron being far more efficient in this particular than a steel furnace such as the open-hearth. It may possibly be necessary on this account only to use ores that are relatively free from sulphur in the direct production of steel.

"2. Another difficulty lies in the different conditions required for the reduction of the ore and the final refining treatment to which the resulting steel must be subjected. Thus the operation of making steel must always be intermittent in character, while the reduction of ore in the blast-furnace is continuous.

"Until these and other difficulties have been overcome, it is not likely that we shall have any successful production of steel directly from iron ore on a commercial scale. Nevertheless, the high price of steel as compared with pig-iron renders this proposition particularly attractive to the electro-metallurgist. At present the most satisfactory method appears to be that of reducing the ore to pig-iron in one furnace, and turning this into steel in a separate furnace as in ordinary metallurgical practice."



The following pages form a descriptive index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

(1) The title of each article,
(3) A descriptive abstract,
(2) The name of its author,
(4) Its length in words,
(5) Where published,
(6) When published,

(7) *We supply the articles themselves, if desired.*

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full title of the principal journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Arches.

Symmetrical Masonry Arches. Malverd A. Howe. A mathematical article showing the method of procedure in applying summation formulæ. 2700 w. R R Gaz—March 13, 1908. No. 90866.

Bascule.

Rolling-Lift Bascule Bridge for the Baltimore & Ohio Ry. at Cleveland, Ohio. Illustrated description of a single-leaf bascule and its operating machinery. 600 w. Eng News—March 12, 1908. No. 90790.

The Bascule Bridge Between Portsmouth and Tiverton, R. I. Illustrated description of a stone bridge with fortress bascule spans. 2500 w. Eng Rec—Feb. 29, 1908. No. 90605.

Blackwell's Island.

Joining of Last Span of Blackwell's Island Bridge. Illustrations with brief account of this cantilever structure. 1800 w. Sci Am—March 28, 1908. No. 91176.

We supply copies of these articles. See page 322.

Cantilever.

See Blackwell's Island, and Quebec, under BRIDGES.

Concrete.

The Connecticut Avenue Bridge at Washington, D. C. Views and descriptive notes of this concrete seven-arch bridge. 600 w. Eng News—March 26, 1908. No. 91172.

Deflection.

See Bridge Deflection, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Design.

A Decade of Bridge Design and Construction. Editorial review of the changes introduced in rebuilding bridges and building of new roads. 2500 w. R R Gaz—March 13, 1908. No. 90861.

Bridge Building in the United States (Der Brückenbau in den Vereinigten Staaten von Nordamerika). F. Dircksen. A discussion of present practice in bridge design. 10500 w. Serial, 1st part. Zeitschr d Ver Deutscher Ing—Feb. 29, 1908. No. 90978 D.

Floors.

Standard Overhead Bridge Floors, Philadelphia. Describes the details of a heavy plate-girder skew bridge carried over seven depressed tracks, and the difficulties overcome. Ills. 1500 w. Eng Rec—March 7, 1908. No. 90700.

Waterproofing Ballasted Bridge Floors at Schenectady, N. Y. In the track elevation of the N. Y. C. & H. R. lines in this city it was important that there should be no leakage in the overhead bridges and viaducts. The methods used are illustrated and described. 3500 w. Eng Rec—March 28, 1908. No. 91201.

Masonry.

The New Stone Bridge Over the Connecticut River at Hartford. E. W. Winans. An illustrated detailed description of a bridge costing about 3,000,000 dollars, composed of nine spans and having a total length of 1192.5 feet. 5000 w. Cassier's Mag—March, 1908. No. 90821 B.

See also Arches, under BRIDGES.

Piers.

Renewing Illinois River Bridge Piers, Toledo, Peoria, and Western. Illustrated description of conditions, and of methods used for this work. 1000 w. Ry Age—March 20, 1908. No. 91102.

Quebec.

Report of the Royal Commission on the Cause of the Collapse of the Quebec Bridge. Henry Holgate, J. G. G. Kerry, John Galbraith, Commissioners. Full report with appendices. 60000 w. Eng Rec—March 14, 1908. No. 90845.

Lessons for the Engineering Profession in the Quebec Bridge Commissioners' Report. Editorial discussion of facts brought out by the report of the Canadian Commission of Engineers. 2000 w. Eng News—March 19, 1908. No. 91020.

Reinforced Concrete.

A Three-Hinge Reinforced-Concrete Skew Arch Bridge in Denver, Col. Illustrated detailed description of a bridge involving special features of interest. 3800 w. Eng Rec—March 21, 1908. No. 91079.

The Wagaraw Bridge at Paterson, N. J. Illustrated description of a three-span reinforced-concrete structure recently built over the Passaic River. 1200 w. Eng Rec—March 7, 1908. No. 90702.

See also Steel, under BRIDGES.

Steel.

New Road Bridges Over the Nile at Cairo. Plan and elevation and other details are shown, with descriptive notes. 1500 w. Engr, Lond—March 13, 1908. Serial, 1st part. No. 91147 A.

A Peculiar Concrete and Steel Bridge in France. Illustrated detailed description of a 3-hinged arch bridge over the Guindy with the haunch hinges some distance up the ring. The material is a curious combination of concrete and steel. 800 w. Eng News—March 26, 1908. No. 91174.

The Bridging of the Columbia and Willamette Rivers Between Vancouver, Wash., and Portland, Ore. Ralph Modjeski. Plate, and illustrated description of two double-track bridges on the Spokane, Portland & Seattle Ry., designed for heavy modern loading, without roadways. 1300 w. Ry Age—March 20, 1908. No. 91101.

See also Bascule, Blackwell's Island, Floors, and Quebec, under BRIDGES.

CONSTRUCTION.

Caissons.

See Foundations, under CONSTRUCTION; and Breakwaters, under WATERWAYS AND HARBORS.

Concrete.

See Piling, under CONSTRUCTION; Concrete, under MATERIALS OF CONSTRUCTION; and Dams, under WATER SUPPLY.

Earthquakes.

The San Francisco Earthquake of April 18, 1906. Joseph H. Harper. Reviews the writer's experience and gives results of personal observations, and lessons to be drawn. 6000 w. Jour Assn of Engng Socs—Feb., 1908. No. 91047 C.

Excavation.

See Dredging, under WATERWAYS AND HARBORS.

Factories.

A Concrete Manufacturing Building. Illustrates and describes the reinforced-

We supply copies of these articles. See page 322.

concrete factory for the Wolf Mfg. Co., at Philadelphia. 1000 w. Cement Age—March, 1908. No. 91053.

Failures.

Investigation of Collapse of Filter Roof During Construction at Lawrence, Mass. Sanford E. Thompson. Paper (condensed) read before the N. Eng. W.-Wks. Assn., explaining the causes of failure of this reinforced-concrete roof. 2500 w. Eng Rec—Feb. 29, 1908. No. 90606.

Fireproofing.

See Steel Buildings, and Warehouses, under CONSTRUCTION.

Floors.

Steel Construction for Long Span Floors in the Chicago Athletic Association Building. No interior columns are used. 43-ft. plate girders are used in the floor system. 600 w. Eng News—March 19, 1908. No. 91019.

Foundations.

Defective Foundations at Mt. Royal Water-Works Pumping Station, Baltimore, Md. Alfred M. Quick. An illustrated detailed description of the conditions and the method of strengthening and reconstructing. 5000 w. Eng News—March 12, 1908. No. 90787.

The Construction of the Base of Baltimore Light, in Chesapeake Bay. H. Prime Kieffer. An illustrated account of a unique salvage undertaking for a large pneumatic caisson, describing this difficult and hazardous work. 5500 w. Eng Rec—March 14, 1908. No. 90837.

Caisson Foundations of Skyscrapers. T. Kennard Thomson, in the *N. Y. Herald*. Illustrated description of the methods of carrying on the work. 2500 w. Sci Am Sup—March 7, 1908. No. 90719.

Foundations: The Use of Divers and the Grouting Machine. Francis Fox. Illustrates and describes interesting applications of the grouting machine to the repairing of old walls and strengthening old foundations. Discussion. 8500 w. Jour Roy Inst of Brit Archts—Feb. 22, 1908. No. 90879 B.

The Effect of Tunneling Operations on St. Paul's Cathedral, London. Notes from an explanation made by Mervyn Macartney to the Royal Institute of British Architects, as to why tunneling near the foundations of St. Paul's Cathedral would cause unequal settlement of the building. 3000 w. Eng Rec—March 28, 1908. No. 91200.

See also Underpinning, under CONSTRUCTION.

Hydraulic Filling.

See Construction, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Industrial Buildings.

See Factories, Reinforced Concrete, and Steel Buildings, under CONSTRUCTION; and Shops, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Masonry.

See Arches, under BRIDGES; Warehouses, under CONSTRUCTION; and Dams, under WATER SUPPLY.

Piling.

Test Loading of a "Compressol" Pile (Probebelastung einer "Compressol"-Pylone). Fritz von Emperger. A discussion of piling as foundation for buildings and test results on a "Compressol" concrete pile. Ills. 5500 w. Beton u Eisen—Feb. 19, 1908. No. 90968 F.

See also Breakwaters, under WATERWAYS AND HARBORS.

Reclamation.

Reclamation Projects in Montana. H. N. Savage. Describes the Huntley project, the Sun River project, the lower Yellowstone, and the St. Mary projects. 1800 w. Jour Assn of Engng Socs—Feb., 1908. No. 91048 C.

The Enclosure of the Zuyder Zee. Reviews the plans for the enclosure and drainage of the Zuyder Zee and the proposed methods of carrying out the work. 1700 w. Engr, Lond—Feb. 28, 1908. No. 90774 A.

Reinforced Concrete.

The Fire of the Dayton Motor Car Works. J. B. Gilbert. An illustrated article showing the effect of the fire on this reinforced-concrete building. 2000 w. Eng Rec—March 28, 1908. No. 91206.

The Foundry Building of Williams, White & Co., Moline, Ill. Brief illustrated description of a reinforced concrete, one-story foundry. 500 w. Eng Rec—March 14, 1908. No. 90841.

The New Freight Depot of the Wisconsin Central Ry. at Minneapolis. S. G. Harwood. Illustrates and describes a reinforced-concrete structure. 1600 w. Eng Rec—March 28, 1908. No. 91202.

Concrete Storehouse and Oilhouse, Battle Creek Mich. Illustrates and describes the interesting features of these buildings in connection with the new shops of the Grand Trunk Railway system. 700 w. Ry Age—March 20, 1908. No. 91099.

The Use of Reinforced Concrete in Engineering and Architectural Construction in America. Ernest R. Matthews. Deals with the use of this material in the construction of water-works, sewers, and sewage disposal works, railway engineering, harbors, building construction, etc., showing its extensive use. Discussion. Ills. 14000 w. Jour Soc of Arts—March 13, 1908. No. 91121 A.

We supply copies of these articles. See page 322.

The Edison Concrete House. E. S. Larned. Conclusions of engineers concerning the practicability of the project. Also paper by Percy H. Wilson on "The Practical Problems Involved." 6000 w. Cement Age—March, 1908. No. 91050.

Concrete Shop Construction with Separately Molded Members. W. H. Mason. Read before the Nat. Assn. of Cement Users. Illustrated detailed description of the cement storage building, erected by the Edison system of casting the members separately. 2500 w. Eng Rec—Feb. 29, 1908. No. 90603.

The Question of Bond. H. F. Porter. A review of the best practice, comparing various types of reinforcement. 1500 w. Cornell Civ Engr—Feb., 1908. No. 90804 C.

A Practical System of Reinforcing Concrete. H. F. Porter. Read before the Engng. Soc. of the University of Toronto. Explains a system based entirely on the use of plain bars. 800 w. Can Engr—March 6, 1908. No. 90778.

The Unit versus the Loose Bar System of Reinforced Concrete Construction. Emile G. Perrot. Read before the Nat. Assn. of Cement Users. Explains how to construct a building with Unit reinforcement for columns, beams, girders, floor and roof slabs. 2000 w. Cement Age—March, 1908. No. 91052.

Economical Design of Reinforced Concrete Beams. Elie Cannes. Gives results of the writer's investigations to determine what percentage of reinforcement will give the least expensive reinforced concrete beam under conditions in New York City. 1200 w. Eng Rec—March 7, 1908. No. 90704.

The Graphical Design of Reinforced-Concrete Structures (Graphostatische Berechnung von Konstruktionen aus Eisenbeton). G. Ramisch. A mathematical discussion of the application of graphical statics to reinforced-concrete design. Ills. 3300 w. Beton u Eisen—Feb. 19, 1908. No. 90969 F.

See also Factories, Failures, and Stacks, under CONSTRUCTION; Sewers, and Sewer Trestle, under MUNICIPAL; Dams, and Reservoirs, under WATER SUPPLY; Breakwaters, under WATERWAYS AND HARBORS; Steel Works, under MINING AND METALLURGY, IRON AND STEEL; and Subways, under STREET AND ELECTRIC RAILWAYS.

Roofs.

See Failures, under CONSTRUCTION.

Stacks.

The Removal of a Tall Steel and Brick Smoke Stack. Brief description of method adopted. Ills. 900 w. Eng Rec—March 14, 1908. No. 90838.

The Design of Ferro-Concrete Chimneys. C. Percy Taylor, Charles Glenday, and Oscar Faber. A study of the stresses allowable in the concrete and steel, referring to two failures in America, and their causes. 3800 w. Engng—March 13, 1908. No. 91140 A.

See also Tanks, under WATER SUPPLY.

Steel Buildings.

The New Open-Hearth Furnace Building, Pennsylvania Steel Works. Illustrates and describes the framework of the furnaces at the Steelton Plant. 2500 w. Eng Rec—Feb. 29, 1908. No. 90607.

Brooklyn Academy of Music. Harry J. Arnold. Description of this new building and the safeguards introduced to prevent fire loss, and loss of life. 2000 w. Ins Engng—March, 1908. No. 90799 C.

New Gas Producer Building, Pennsylvania Steel Works. Illustrated description of the producer house at Steelton, Pa., which will supply gas for the five new 75-ton open-hearth furnaces. 1700 w. Eng Rec—March 21, 1908. No. 91082.

The Phelan Building, San Francisco. Illustrated description of original methods of construction applied to a 11-story building in the earthquake district. 3000 w. Eng Rec—March 28, 1908. No. 91199.

See also Floors, under CONSTRUCTION.

Tunnels.

The Engineering Difficulties of the Hudson & Manhattan Tunnel. From an address by Charles M. Jacobs before the Yale Club, describing some of the problems. 1600 w. R R Gaz—March 20, 1908. No. 91075.

The New York Subaqueous Tunnels (Les Tunnels Sous--marines de New York). Edmond Henry. A general description of the various railway tunnels entering the city under the North and East Rivers. Ills. 4500 w. Génie Civil—Feb. 29, 1908. No. 90926 D.

See also Foundations, under CONSTRUCTION; and Subways, under STREET AND ELECTRIC RAILWAYS.

Underpinning.

Underpinning Buildings Adjacent to the Bridge Loop Subway, New York. States the conditions and describes the methods used. Ills. 1200 w. Eng Rec—March 7, 1908. No. 90701.

Warehouses.

Fireproof Storage Warehouses. Joseph B. Baker. Illustrates and describes the solid brick building of the Security Storage Co., of Washington, D. C., which is built in units having independent walls, designed with the idea of localizing losses from fires. 1500 w. Ins Engng—March, 1908. No. 90798 C.

Waterproofing.

See Floors, under BRIDGES.

MATERIALS OF CONSTRUCTION.

Brick.

Working Loads on Brickwork. Compares the results of values from the Royal Institute tests, the Watertown Arsenal tests, and other sources. 2000 w. Builder—March 14, 1908. No. 91125 A.

Cement Tiles.

Results of Tests of Cement Drain Tiles. A report of tests made at the laboratories of the Iowa State College. 1800 w. Engng-Con—March 25, 1908. No. 91191.

Concrete.

Fundamental Formulæ for the Testing of Concrete (Entwicklung von Grundformeln für Untersuchung von Körpern aus Beton). Prof. Ramisch. A mathematical paper. Ills. 2500 w. Elektrotech Rundschau—Feb. 19, 1908. No. 90951 D.

Concrete Blocks.

Standard Rules and Regulations Governing Concrete Hollow Block. Gives rules and test requirements adopted by the National Assn. of Cement Users. 3000 w. Eng Rec—March 7, 1908. No. 90699.

Standard Specifications for Concrete Hollow Blocks. Gives the rules and regulations proposed by the Committee of the National Assn. of Cement Users. 5500 w. Cement Age—Feb., 1908. No. 91039.

Steel.

New Forms of Steel for New Uses. R. B. Woodworth. Considers the factors that have caused the substitution of steel for wood in building construction, and modern methods of substructure construction; illustrates and describes many types of bars, piling, etc., and uses made of steel in dam-building, coal mining, etc. Also discussion. 10000 w. Pro Engrs' Soc of W Penn—Feb., 1908. No. 90835 D.

MEASUREMENT.

Surveying.

Practical Points on Surveying. Charles L. Hubbard. Describes briefly the use of transit and level, methods of taking measurements, arrangement of notes, and the plotting of results. Ills. 3500 w. Mach, N Y—March, 1908. No. 90641 C.

MUNICIPAL.

Garbage Disposal.

The Chicago Garbage Reduction Plant. Emmons J. Alden. Illustrated detailed description of an extensive plant and its operation. Also editorial on "Garbage Reduction and Incineration Plants in the Larger Cities of the United States." 3500 w. Eng News—March 12, 1908. No. 90792.

Pavements.

Pavements in Salt Lake City, Utah. Photographs of streets showing various kinds of paving materials, and information from the report of L. C. Kelsey, City Engineer. 1500 w. Munic Engng—March, 1908. No. 91036 C.

Vitrified Brick Pavement Construction. Will P. Blair. Gives points on the best construction. Ills. 1200 w. Munic Jour & Engr—March 4, 1908. No. 90684.

Good Pavements and How to Secure Them. J. W. Howard. From an address before the Civic Assn. of Morristown, N. J. Considers the influence of good pavements, and outlines the general principles of construction. 2000 w. Munic Engng—March, 1908. No. 91037 C.

Peking.

The Public Works of Peking. J. D. Smedley. An illustrated description of the city, its streets, sewers, water supply, etc. 3000 w. Pub Works—Jan., 1908. No. 90652 B.

Public Baths.

The Public Bath. Harold Werner and August P. Windolph. Discusses the development of the types of public baths, with suggestions on planning, structural peculiarities, etc. Ils. 2500 w. Br Build—Feb., 1908. No. 90722 D.

Roads.

Improved Roads—The "Durax" Granite System. Illustrated description of this form of paving. 1500 w. Auto Jour—Feb. 22, 1908. No. 90648 A.

Object Lesson Roads Built in 1906-07 by U. S. Office of Public Roads, with Data on Their Cost. Descriptions and data from the report of Logan Waller Page. 2500 w. Engng-Con—March 4, 1908. No. 90713.

Gravel and Macadam Roads and Their Cost. G. C. Houston. From a paper before the Indiana Engng. Soc. Information concerning road construction in Southern Indiana. 2000 w. Munic Engng—March, 1908. No. 91038 C.

Some Points in Road Construction. E. B. B. Newton. Read before the Munic. & Allied Foremen's Inst. The present number considers foundations, selection of materials, camber, channels and crossings, and paving materials. 2500 w. Surveyor—March 13, 1908. Serial, 1st part. No. 91124 A.

Present-Day Road Requirements in Town and Country. A. Brown. States the requirements, describes city pavements, discussing how far they meet these requirements, the dust problem, etc. General discussion. 8400 w. Surveyor—Feb. 21, 1908. No. 90655 A.

The Problem of Road Construction with a View to Modern and Future Requirements. H. S. Hele-Shaw, and Douglas Mackenzie. Considers how far the various improvements in road-making

We supply copies of these articles. See page 322.

satisfy modern requirements. General discussion. 8500 w. Jour Soc of Arts—Feb. 28, 1908. No. 90755 A.

Treatment and Formation of Road Surfaces. A. J. Metcalfe. Indicates how the construction of motor cars might be improved so as to lessen the dust trouble, and discusses road improvements, materials and methods. 8800 w. Soc of Engrs—March 2, 1908. No. 91211 N.

The Use of Tar on Macadam Roads (L'Emploi du Goudron sur les Chaussées Empierrées). P. Caufourier. A discussion of its effect on the cost of maintenance. 3200 w. Génie Civil—Feb. 15, 1908. No. 90922 D.

Sewage Disposal.

A Sewage Disposal Plant for a Large Hotel at Bedford, Pa. T. Chalkley Hatton. States the conditions and describes the method of solving the problem. Ills. 1500 w. Eng Rec—March 28, 1908. No. 91203.

The New Sewage Purification Works for Berlin-Wilmersdorf, Germany. William Paul Gerhard. Illustrated detailed description. 3300 w. Eng News—March 19, 1908. No. 91018.

Sewage Purification in Ohio. Notes from a preliminary report by R. Winthrop Pratt, on the conditions at the sewage-purification plants of the state. 3000 w. Eng Rec—Feb. 29, 1908. No. 90604.

Sewage Purification for the City of New York. Walter E. Parfitt. Gives a map showing the vast amount of sewage emptied into New York Bay, discussing the need of its purification, and describing a purification system in which hypochlorous gas is forced into sewage under pressure. Ills. Discussion. 8000 w. Pro Brooklyn Engrs' Club, No. 73—Vol. XI, 1907. No. 91237 N.

The Birmingham Sewage Purification Plant and the Action of Tamworth Against Birmingham (Die Abwasserreinigungsanlagen von Birmingham und der Prozess Tamworth contra Birmingham). Dr. Dunbar. Illustrated description of the Birmingham plant and its effects on Tamworth which resulted in a long litigation. 8500 w. Gesundheits-Ing—Feb. 29, 1908. No. 90972 D.

The Intensive Biological Treatment of Sewage (L'Epuration Biologique Intensive des Eaux d'Egout). M. B. Bezault. A reply to M. Vincey's paper. Defends biological treatment as against the spreading process. Ills. 8500 w. Bul Soc d'Encour—Jan., 1908. No. 90909 G.

See also Filtration, under WATER SUPPLY; and Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Sewers.

Reinforced-Concrete Intercepting and Outfall Sewer, Waterbury, Conn. William Gavin Taylor. States the conditions and gives an illustrated detailed description of the combined intercepting and outfall sewer nearing completion. 3500 w. Eng News—March 26, 1908. No. 91175.

The Graphical Determination of the Maximum Capacity of a City Sewerage System (Ueber die zeichnerische Bestimmung der Grösstabflussmengen in städtischen Kanalnetzen). Herr Range. Illustrated description and explanation of method. 3600 w. Serial. 1st part. Zeitschr d Oest Ing u Arch Ver—Feb. 7, 1908. No. 90966 D.

Sewer Trestle.

A Reinforced-Concrete Sewer Pipe Trestle. Illustrates and describes a trestle built in Los Angeles, Cal., to carry an intercepting sewer across a river. 1400 w. Eng Rec—March 14, 1908. No. 90842.

Snow Removal.

The Economies of Snow Removal and a Suggested Improvement Over the Present Methods Used in New York. Richard T. Dana. Outlines a method of weighing the snow removed. 1400 w. Engng-Con—March 4, 1908. No. 90714.

Street Cleaning.

See Snow Removal, under MUNICIPAL.

WATER SUPPLY.

Aqueducts.

See Reservoirs, under WATER SUPPLY.

Conduits.

See Los Angeles, Cal., under WATER SUPPLY.

Dams.

The Raising of the Assuan Dam. Gives the reasons for the heightening of the dam, and answers criticisms. 1700 w. Engr, Lond—Feb. 21, 1908. No. 90670 A.

The Construction of the Main Dam of the Croton Falls Reservoir. Illustrates and describes the methods of construction used in building this masonry and concrete dam. 4500 w. Eng Rec—March 28, 1908. No. 91204.

A Concrete and Earth Diversion Dam in California. Detailed account of the design and construction of a dam on the Eel River, which involves features of interest due to the character of the stream and to foundation conditions. 4500 w. Eng Rev—March 14, 1908. No. 90839.

Filtration.

The Design of a Rapid-Sand Water Filtration Plant. H. A. Gehring. Describes a plant for a village under 3000, allowing for a daily per capita consumption of 100 gallons. 3000 w. Cornell Civ Engr—Feb., 1908. No. 90805 C.

Novelties in Filtration and Their The-

ory. Ad. Kemna. A review of special features introduced in various countries, considering their value. Also editorial on the removal of suspended matters from water and sewage. 8000 w. Eng News—March 26, 1908. No. 91173.

Operating Results at the Harrisburg Filters. Information from the annual report of the Harrisburg, Pa., water-works. 2000 w. Eng Rec—March 14, 1908. No. 90843.

Continuous Filtration of Bath Water: A Description of Its Working. Robert J. Angel. Read before the Assn. of Munic. & Co. Engrs. Describes a system for maintaining the purity of water used in swimming baths, stating the advantages claimed. Ills. Discussion. 6500 w. Surveyor—March 13, 1908. No. 91123 A.

The Filter Plant of the Vienna Water Supply at Tullnerbach (Das Filterwerk der Wientalwasserleitung in Tullnerbach). Johann Vogler. A description of the plant and the results obtained. Ills. 10000 w. Oest Zeit f d Oeffent Baudienst—Feb. 8, 1908. No. 90973 D.

See also Tanks, under WATER SUPPLY.

Fire Protection.

New York's Electrically-Operated, High Pressure Water System for Fire Protection. Illustrates and describes both the Brooklyn and Manhattan systems. 2200 w. Elec Wld—March 14, 1908. No. 90784.

The Fire Department and the High Pressure System. Peter J. McKeon. A critical discussion of the advantages and shortcomings of the high-pressure system. Ills. 4500 w. Cassier's Mag—March, 1908. No. 90818 B.

High Pressure.

See Fire Protection, under WATER SUPPLY.

Irrigation.

Irrigation in Egypt Under British Direction. Sir Hanbury Brown. A review of what has been done under British direction, exclusive of the basin tracts of Upper Egypt and the Sudan. General discussion. 11400 w. Jour Soc of Arts—March 13, 1908. No. 91120 A.

Los Angeles, Cal.

The Water Supply System of Los Angeles, Cal. Outlines the history, and gives an illustrated description of the works recently built to increase the supply. 6000 w. Eng Rec—Feb. 29, 1908. No. 90602.

Pollution.

The Pollution of Waters at Common Law and Under Statutes. Charles F. Choate, Jr. Discusses the property rights as protected by the common law, and the statutes for the protection of public health. General discussion. 9500 w. Jour Assn of Engng Socs—Feb., 1908. No. 91046 C.

Reservoirs.

The Reinforced Concrete Reservoirs and Aqueduct of Mexico City. James D. Schuyler. Illustrated detailed description of extensive and unusual construction of four large circular reservoirs, lined and roofed with armored concrete, and also a large conduit of the same material. 4000 w. Eng Rec—March 28, 1908. No. 91198.

See also Los Angeles, Cal., under WATER SUPPLY.

Salt Lake City.

The Water-Supply System of Salt Lake City, Utah. Describes the conditions in this semi-arid region, and the water rights; Utah Lake pumping station and the conduit system. Ills. 4000 w. Eng Rec—March 21, 1908. No. 91083.

Tanks.

Sand Filters and Clear-Water Tanks for Small Water-Works. Drawings for the Hamilton Water Supply Works, in Lanarkshire, with description. 1500 w. Engng—March 6, 1908. No. 91002 A.

The Construction of a Combined Smokestack and Water Tank. H. Stoffels. Plans and detailed description of this structure and the calculation of the stresses. 800 w. Engng News—March 12, 1908. No. 90789.

Water Meters.

Notes on the Measurement of Flowing Water. Ernest W. Schoder. Some of the more simple and common methods of measurement and their accuracy are discussed. 2000 w. Cornell Civ Engr—March, 1908. No. 91227 C.

Water Towers.

A Very Large Water Tower. A tank, supported on a tall steel tower, recently constructed at Louisville, Ky., is illustrated and described. 2200 w. Eng Rec—March 7, 1908. No. 90703.

Water Works.

Small Water Supplies. H. C. H. Shenton. Discusses in detail the general design of a water-works system, and how the supply may be best conducted to the required places. Ills. 12700 w. Pub Works—Jan., 1908. No. 90651 B.

Gas Engine Water Works Plant at Brookville, O. H. E. Couts. Illustrated description of a small plant serving a population of 1200. Water is obtained from four artesian wells, the engine room equipment consists of power pumps and air compressors belted to gas engines. 1200 w. Engr, U S A—March 16, 1908. No. 90859 C.

See Salt Lake City, under WATER SUPPLY.

We supply copies of these articles. See page 322.

Well Driving.

California Stove-Pipe Wells on Long Island. Describes the method of driving these wells, and the outfit used. Ills. 2500 w. Eng Rec—Feb. 29, 1908. No. 90608.

WATERWAYS AND HARBORS.

Barge Canal.

The New York Barge Canal vs. the Deep Waterway. A critical letter from Col. Thomas W. Symons, with editorial comments on the questions discussed. 3500 w. Eng News—March 5, 1908. No. 90696.

Blyth.

Blyth Harbor Improvements. Brief review of the development of this port and illustrated description of the extensive improvements now in progress, including the reconstruction of piers, erection of lighthouse, underpinning quay wall, deepening of the harbor, etc. 2500 w. Engr, Lond—March 6, 1908. No. 91006 A.

Breakwaters.

A Novel Breakwater for Algoma Harbor, Wis. Brief description of a breakwater consisting of reinforced concrete caissons, resting on pile foundations. Ills. 1000 w. Eng Rec—March 21, 1908. No. 91084.

Canal Haulage.

Notes on Electric Haulage of Canal Boats. Lewis B. Stillwell and H. St. Clair Putnam. An account of tests made on the Lehigh Canal, near Mauch Chunk, Pa., and the results. Ills. 4500 w. Pro Am Inst of Elec Engrs—March, 1908. No. 90832 D.

Mechanical Haulage on Canals. Editorial discussion of the report recently issued by the British royal commission dealing with this subject. 1400 w. Ry Age—March 6, 1908. No. 90753.

Canals.

See Barge Canal, Georgian Bay Canal, and Panama Canal, under WATERWAYS AND HARBORS.

Coast Defense.

Some Engineering Features of Coast Defense. Kingsley L. Martin. Considers the engineering methods which enter into the work done. Discussion. 6000 w. Pro Brooklyn Engrs Club, No. 78—Vol. XI, 1907. No. 91242 N.

Coast Protection.

Erosion of the Coast and Its Prevention. F. W. S. Stanton. The first of a series of articles discussing the agents of destruction and construction, especially their effects on the English coast, and methods of coast defense. 2800 w. Pub Works—Jan., 1908. No. 90654 B.

Dredging.

Subaqueous Rock Removal. Brysson Cunningham. Illustrates and describes the methods available for this work. 2500 w. Cassier's Mag—March, 1908. No. 90824 B.

A Sub-Aqueous Rock-Cutter Dredger. Benjamin Taylor. Illustrated description of a rock-cutter just completed for operation on the river Blyth, Northumberland. 1500 w. Int Marine Engng—April, 1908. No. 91107 C.

A Novel Dredge Director. Illustrates and describes a machine, recently designed, by means of which the operator can so control the movements of the dredge as to produce a cross-section of excavation of any desired shape. 1000 w. Int Marine Engng—April, 1908. No. 91108 C.

The Fruhling System of Suction Dredging. John Reid. Shows some of the causes for the low efficiency of the ordinary suction dredge and gives an illustrated description of the improved system developed by Otto Fruhling, of Germany. 3500 w. Eng News—March 5, 1908. No. 90690.

The Cost of Hydraulic Dredging on the Mississippi River. A memorandum by Lieut. Col. Clinton B. Sears for the Board of Engineers on the Improvement of the Ohio River. 1200 w. Eng Rec—March 21, 1908. No. 91086.

Georgian Bay Canal.

The Montreal, Ottawa and Georgian Bay Canal. On the inportance of this canal project, and the route selected. 3000 w. Marine Rev—March 12, 1908. No. 90836.

Harbors.

See Blyth, under WATERWAYS AND HARBORS; and Terminals, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Lighthouses.

See Foundations, under CONSTRUCTION.

Panama Canal.

The Strategical and Economical Effect of the Opening of the Panama Canal. Archibald R. Colquhoun. Outlines the present state of affairs in this great undertaking, and aims to show that the immediate result will be a great naval development of the United States. Considers briefly the strategic importance to Gt. Britain of retaining a stronghold in the Caribbean Sea. Also discussion. Maps. 12,000 w. Jour Roy U Serv Inst—Feb., 1908. No. 90685 E.

U. S. Waterways.

Preliminary Report of the Inland Waterways Commission. The message of the President and the commission's report are given in condensed form, with editorial comment. 6500 w. Eng News—March 5, 1908. No. 90694.

We supply copies of these articles. See page 322.

Some of the Engineering Problems Involved in the Construction of a Deep Waterway from the Great Lakes to the Gulf of Mexico. J. A. Ockerson. The problems of a deep waterway by the way of the Illinois and Mississippi rivers are discussed. Ills. 6000 w. Jour Assn of Engng Socs—Feb., 1908. No. 91049 C.

MISCELLANY.

Grubbing.

Methods of Grubbing Stumps and Trees. Illustrated description of methods used. 2500 w. Engng-Con—March 25, 1908. No. 91192.

Natural Resources.

Conservation of National Resources. H. M. Wilson. Brief account of the work being done by the U. S. Geol. Survey to reduce the waste of timber, fuel, mineral, lands and water. 1200 w. Cement Age—March, 1908. No. 91051.

Sand Damage.

Sand Waves and Their Work. Day Allen Willey. An illustrated article describing the ravage in desert regions, and some methods of fighting the sand. 2000 w. Sci Am Sup—Feb. 22, 1908. No. 90588.

ELECTRICAL ENGINEERING

COMMUNICATION.

Radio-telegraphy.

Mr. Marconi on Wireless Telegraphy. Abstract of an address before the Chamber of Commerce, at Liverpool. Considers applications made and how it can be further utilized in the interests of commerce and industry. 2500 w. Electn, Lond—Feb. 28, 1908. No. 90766 A.

Wireless Telegraph Plant at the United States Naval Academy. W. H. G. Bullard. Illustrated description of this station at Annapolis, Md., and its equipment; also describing the instruction given midshipmen. 2000 w. Elec Wld—March 21, 1908. No. 91015.

Telegraphy.

See Telepost, under COMMUNICATION.

Telemechanic.

Dr. Branly's "Tele-Mechanic" Apparatus and Protecting Device. Louis Dubois. Describes this apparatus for controlling electrical apparatus at a distance by means of electric waves, and also a protecting apparatus to prevent accidental sparks from taking effect. Ills. 2500 w. Elect'n, Lond—March 6, 1908. No. 90895 A.

Telephone Cables.

Aerial and Underground Construction. C. H. Judson. Abstract of a paper read before the Int. Ind. Tel. Assn. Arguments, and comparisons, showing that underground conduits are in the end more economical. 2000 w. Elec Rev, N. Y.—March 7, 1908. No. 90726.

See also Cables, under TRANSMISSION.

Telephone Lines.

The Standard Specifications for Telephone Lines of the United States Reclamation Service. Outlines the proper construction. 3000 w. Eng News—March 12, 1908. No. 90793.

Telephony.

The Telephone System of the Transvaal. J. Grant. Gives the history of the development and present state of this industry, giving map and diagrams. 4000 w. Jour S African Assn of Engrs—Jan., 1908. No. 90756 F.

The Propagation of Telephonic Currents Through Underground Conductors. H. Abraham and Devaux-Charbonnel. Trans. from *Comptes Rendus*. Investigations to determine whether the actual propagation of telephonic currents is sufficiently represented by the well-known formulæ. 1200 w. Elect'n, Lond—Feb. 28, 1908. No. 90765 A.

See also Phase Differences, under MEASUREMENT.

Telephotography.

Telephotography (La Téléphotographie). G. Cerbelaud. A review of its development and the present systems. Ills. 4800 w. Génie Civil—Feb. 1, 1908. No. 90919 D.

Telepost.

"Electro-Magnetic" Automatic Telegraphy. ("The Telepost.") Patrick B. Delany. Illustrated explanation of a new method, its advantages and applications. 3500 w. Jour Fr Inst—March, 1908. No. 91064 D.

DISTRIBUTION.

Fuses.

Fuse Phenomena. Alfred Schwartz and W. H. N. James. Discusses points to be considered in choosing a suitable metal for a fuse. Also the rating of fuses. Ills. 10000 w. Inst of Elec Engrs—March 5, 1908. No. 90893 N.

Switchboards.

See same title, under GENERATING STATIONS.

Switches.

The Design of Battery Switch Connections (Bemessung von Zellenschalterleitungen). Franz Steindl. A mathematical

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discussion of single and double battery switches. Ills. 2000 w. Elektrotechnik u Maschinenbau—Feb. 16, 1908. No. 90-965 D.

DYNAMOS AND MOTORS.

A. C. Motors.

A Method for Calculating the Short-Circuit Current in Three-Phase Motors. W. Oelschläger. Abstracted from the *Elektrotechnische Zeitschrift*. Shows a method whereby the short-circuit current can be calculated directly from the main dimensions of the machine. 1000 w. Elect'n, Lond—March 13, 1908. No. 90-999 A.

See also Railway Motors, under DYNAMOS AND MOTORS.

Brushes.

Standardization Tests on Carbon Brushes for Dynamos and Motors. Abstracted from the *Bul. de la Soc. Int. des Electns.* Tests including determinations of density, porosity, tensile strength and compression as well as wear, resistivity and friction 2500 w. Elect'n, Lond—Feb. 28, 1908. No. 90763 A.

D. C. Dynamos.

A New Train-Lighting Dynamo. Explains the principle of the direct-current dynamo recently brought out by the Felten & Guilleaume-Lahmeyer Werke. Ills. 1000 w. Elec Rev, Lond—Feb. 21, 1908. No. 90660 A.

Flame-proof Motors.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Insulation.

Coil Insulation in Electrical Apparatus. J. A. Jacobs. Read before the Ohio Soc. of Mech., Elec., & Steam Engrs. Considers the wire insulation, internal insulation, and external insulation. 2200 w. Engr, U. S. A.—March 16, 1908. No. 90860 C.

Insurance.

See same title, under GENERATING STATIONS.

Railway Motors.

The Alternating Current Railway Motor. S. M. Kintner. States the points in which alternating-current railways show improvement over direct-current; discusses motors suited to the two kinds of service, especially the single-phase motor and matters relating to it. Ills. 4500 w. Pro Engrs' Soc of W Penn—Feb., 1908. No. 90834 D.

Windings.

Square-Core and Round-Core Windings. Charles R. Underhill. Discusses the calculation of windings for electromagnets with cores of square or rectangular cross-section. 1200 w. Elec Wld—March 28, 1908. No. 91171.

ELECTRO-CHEMISTRY.

Diaphragms.

Diaphragms. J. R. Crocker. Gives a brief description of the attempts which have been made to meet the varied requirements when diaphragms are necessary. Ills. 2500 w. Elec-Chem & Met Ind—April, 1908. No. 91250 C.

Electro-Metallurgy.

Electric-Furnace Reactions Under High Gaseous Pressures. R. S. Hutton and J. E. Petavel. Abstract of paper communicated to the Royal Soc. Describes the large high pressure furnace used and the investigations carried out. 9000 w. Engng—Feb. 21 and 28, 1908. Serial. 2 parts. No. 90769 each A.

Electric-Furnace Reactions Under High Pressure. Dr. R. S. Hutton and J. E. Petavel. Extract from a paper before the Royal Soc. of London. Illustrates and describes interesting experiments with high pressures. 2500 w. Elec-Chem & Met Ind—March, 1908. No. 90642 C.

See also same title, under MINING AND METALLURGY, IRON AND STEEL; and Aluminium, under MINING AND METALLURGY, MINOR MINERALS.

Electro-plating.

The Rapid Deposition of Nickel. Illustrated description of Canning's method of agitating a nickel plating solution. 900 w. Brass Wld—March, 1908. No. 91060.

Electro-deposition of Copper and Tin Bronze. Observations and results of experience with deposits of this nature. 1300 w. Brass Wld—March, 1908. No. 91059.

Method for the Determination of the Free Cyanide in Silver and Copper Plating Solutions. Describes the process of testing the plating solution. 2000 w. Brass Wld—March, 1908. No. 91058.

Hydrogen.

The Electrolytic Production of Hydrogen and Its Application to Aeronautics and in Other Fields (Die Elektrolytische Gewinnung des Wasserstoffs und seine Verwendung für Luftschiffahrts und andere Zwecke). Describes the process and necessary plant. Ills. 1400 w. Serial. 1st part. Elektrochem Zeitschr—Feb., 1908. No. 90945 G.

ELECTRO-PHYSICS.

Induction.

A New Factor in Induction; the "Loop" vs. the "Cutting Lines of Force" Laws. Carl Hering. A discussion of the two working hypotheses for explaining quantitatively the induced electromotive force. Also editorial. 4800 w. Elec Wld—March 14, 1908. No. 90785.

An Imperfection in the Usual Statement of the Fundamental Law of Electromagnetic Induction. Carl Hering. Points

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out that it is not correct as a universal law, and requires to be modified; proof is given by a simple experiment. 3500 w. Pro Am Inst of Elec Engrs—March, 1908. No. 90833 D.

See Current Balance, under MEASUREMENT.

GENERATING STATIONS.

Accumulators.

The Care of Storage-Battery Cells. William Kavanagh. Considers how to maintain a battery in the most efficient condition. 1200 w. Power—March 17, 1908. No. 90876.

Central Stations.

Combined Central-Station and Water-Pumping Plant. A plant at Pine Bluff, Ark., a city of about 20,000 inhabitants, is illustrated and described. 1600 w. Elec Wld—Feb. 29, 1908. No. 90617.

Steam Turbine Power and Transmission Plant of the Moctezuma Copper Company, at Nacozari, Sonora, Mexico. John Langton and Charles Legrand. Illustrated description of the plant and its equipment. 5000 w. Can Soc of Civ Engrs—March 5, 1908. No. 91210 N.

See also Electric Power, under MINING AND METALLURGY, MINING.

Design.

Coupling Gas- and Steam-Engine Driven Generators (Couplage d'un Groupe Moteur à Gaz avec des Groupes Moteurs à Vapeur). C. Roche. Describes interesting work at the Biarritz station in arranging for the parallel operation of single-phase dynamos driven by gas and steam power. Ills. 2500 w. Génie Civil—Feb. 1, 1908. No. 90920 D.

Economics.

Publicity for Small Undertakings. Remarks referring to towns of 30,000 inhabitants, or less. 2200 w. Elec Rev, Lond—Feb. 28, 1908. Serial. 1st part. No. 90762 A.

A Handy Curve Sheet. John B. Morgan. A brief description of a method of plotting central-station outputs and costs in the form of curves. 800 w. Elec Rev, Lond—Feb. 28, 1908. No. 90761 A.

Poor Light Complaints—A Central Station Problem. H. N. Muller. Briefly considers the causes of dissatisfaction with the lighting service, especially discussing the logic of free lamp renewals. 2500 w. Elec Jour—March, 1908. No. 90796.

The Electric Motor Load from the View Point of Central-Station Service. Charles K. Nichols. An illustrated article considering some of the applications that help to develop the power load. 3000 w. Elec Wld—March 7, 1908. No. 90730.

I. Electric Service of the Fitchburg Gas & Electric Company. William H. Stuart. Illustrated description of the plant and the business methods. II. Electric Power, Its Progress and Possibilities. A. H. Kimball. A detailed account of the building up of the Fitchburg power load and motor service. 3000 w. Elec Wld—March 7, 1908. No. 90729.

See also Electric Driving, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Hydro-Electric.

The Kashmir Hydroelectric Works. Cy. Whitwell. Illustrated description of a development in India. 2000 w. Elec Rev, N Y—March 28, 1908. No. 91187.

A Hydro-Electric Development in Utah. Illustrates and describes a development recently placed in operation by the Telluride Power Co., which supplies power for mining and smelting and for various other purposes. 4000 w. Eng Rec—March 14, 1908. No. 90844.

The Colliersville Hydro-Electric Plant. Illustrated description of a power-plant on the Susquehanna River, in Otsego Co., N. Y., to furnish power for a 65-mile line of railway and for power and lighting purposes. 2000 w. Eng Rec—March 7, 1908. No. 90698.

The Hydro-electric Plant of the Rockingham Power Company. Julian S. Miller. An illustrated account of a plant on the Pee Dee River, North Carolina, being constructed to supply 28,800 hydroelectrical horse-power. 3000 w. Elec Rev, N Y—March 14, 1908. No. 90846.

The Sioule Hydro-Electric Plant (Usine Hydraulico-Électrique de la Sioule). J. A. Montpellier. Illustrated description of a 1200 horse-power plant in France. 3200 w. Serial. 1st part. Elect'n—Feb. 22, 1908. No. 90914 D.

The Hydro-Electric Plant at Brillanne on the Durance (Usine Hydro-Electrique de la Brillanne sur la Durance). A. Bidault des Chaumes. Illustrated description of this 3500 horse-power plant. 3500 w. Génie Civil—Feb. 22, 1908. No. 90923 D.

The Lebring Electric Plant, Steiermark (Das Elektrizitätswerk Lebring in Steiermark). Illustrated detailed description of building and hydraulic and electrical installations. 2800 w. Serial. 1st part. Elektrotech u Maschinenbau—Feb. 9, 1908. No. 90964 D.

See also Turbines, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

Insurance.

The Insurance of Electrical Plant Against Breakdown. William R. Bowker. An account of this business in Great Britain and the methods that have made it a profitable venture. 4500 w. Cassier's Mag—March, 1908. No. 90819 B.

We supply copies of these articles. See page 322.

London.

Bulk Supply in Greater London Area. J. Horace Bowden and Fred Tait. A critical discussion of the schemes put forward. 2200 w. Elec Rev, Lond—March 6, 1908. Serial. 1st part. No. 90892 A.

Porto Rico.

Electrical Developments in Porto Rico. An illustrated account of the construction of railways and electrical plants for power and light. 1500 w. Elec Wld—March 28, 1908. No. 91169.

Switchboards.

Some Notes on Switchboard Operation in Alternating-Current Stations. H. R. Mason. Calls attention to seemingly trifling things which are productive of disastrous results. 1800 w. Power—March 10, 1908. No. 90747.

LIGHTING.

Electric vs. Gas.

The Development and Present Position of Gas and Electricity for Lighting. Sydney F. Walker. A review of the early history of electric lighting and the effect on the gas industry, the competition, and future outlook. 2200 w. Cent Sta—March, 1908. No. 90744.

The Relative Hygienic Values of Gas and Electric Lighting. Samuel Rideal. Reports an inquiry made to determine and compare the hygienic effects of gas and electricity as used for ordinary domestic lighting. 28000 w. Jour Roy San Inst—March, 1908. No. 90829 B.

Illumination.

Influence of the height of Suspension Upon Uniform Illumination. Alfred A. Wohlauer. A study of illumination by means of a number of similar equidistant lamps at a uniform elevation. Also editorial. 2200 w. Elec Wld—March 21, 1908. No. 91016.

A New Graphic Method for Determining the Mean Spherical Intensity of a Lamp by the Length of a Straight Line When the Curve of Mean Meridional Intensity is Given. A. E. Kennelly. Analyzes examples of the use of the Rousseau diagram, and explains the new method. Editorial note. 3300 w. Elec Wld—March 28, 1908. No. 91170.

Incandescent Lamps.

The New Metal Flament Lamps: Their Qualities and Their Commercial Importance. H. Remané. Abstract of a paper read before the Elektrotechnische Verein, in Leipzig. Information relating to the manufacture of the filaments, and their efficiency. 2200 w. Elec Engr, Lond—Feb. 21, 1908. No. 90659 A.

Photometry.

Primary Standard of Light. Charles P. Steinmetz. Recommends mercury lamps as the sources of three monochromatic radiations, which combined give the primary standard of light. 12000 w. Pro Am Inst of Elec Engrs—March, 1908. No. 90831 D.

Working Standards of Light and Their Use in the Photometry of Gas. Charles O. Bond. Considers the qualities an ideal working standard would possess, and discusses the standards in general use in America. Ills. 5500 w. Jour Fr Inst—March, 1908. No. 91065 D.

MEASUREMENT.

Current Balance.

A New Current Weigher and a Determination of the E. M. F. of the Normal Weston Cadmium Cell. Prof. W. E. Ayrton, T. Mather, and F. E. Smith. Illustrates and describes an instrument designed and made by the authors, for the absolute determination of current. 3000 w. Elect'n, Lond—Feb. 28, 1908. No. 90764 A.

Meter Testing.

Testing Electric Meters at Their Place of Installation. Joseph B. Baker. The present article deals with the outfit needed in testing meters on the consumers' premises. Ills. 1200 w. Elec Wld—March 7, 1908. Serial. 1st part. No. 90728.

Phase Differences.

The Direct Measurement of Differences of Phase by the Abraham Galvanometer and Its Applications in Telephony (Emploi du Galvanomètre Abraham pour la Mesure Directe des Différences de Phase. Applications à la Téléphonie). M. Devaux-Charbonnel. Describes the instrument and gives a mathematical discussion of its use. Ills. 5300 w. Bul Soc Int des Elec'ns—Feb., 1908. No. 90904 F.

Resistance.

A Resistance Comparator. W. Clark Fisher. Discusses the advantages of the potentiometer method of comparing resistances, and describes the author's designs. Also refers to the plotting of results. Ills. 2000 w. Elect'n, Lond—March 6, 1908. Serial. 1st part. No. 90894 A.

TRANSMISSION.

Cables.

Electric Cables. Henry W. Fisher. Notes on the improvements made in this industry in the last twenty years. Ills. 2000 w. Sib Jour of Engng—March, 1908. No. 91067 C.

Condensers.

The Use of Condensers on High-Tension Circuits. From *Elektrische Kraftbetriebe und Bahnen.* Shows how they can be advantageously used, especially in connection with the protection of transmission lines against voltage rises. 1100 w. Elec Engr, Lond—March 6, 1908. No. 90890 A.

We supply copies of these articles. See page 322.

Conduits.

The Underground Conduit System for Electric Light and Power Wires. A. J. Quigley. Deals with the construction of an underground conduit system for the city of Davenport, Ia. Ills. 3500 w. Wis Engr—Feb., 1908. No. 91224 D.

Grounds.

Notes on Resistance of Gas-Pipe Grounds. J. L. R. Hayden. Gives results of an investigation made to get data in the resistance offered by gas-pipe grounds, their permanence and variation. Also discussion 1500 w. Pro Am Inst of Elec Engrs—March, 1908. No. 90830 D.

Line Construction.

See Telephone Lines, under COMMUNICATION.

Line Design.

A Transmission Line Considered as a Mechanical Structure. W. T. Ryan. Gives equations made use of in the mechanical design of the line. 2000 w. Elec Wld—Feb. 29, 1908. No. 90618.

Rotary Converters.

The Cascade Converter (Kaskadenumformer). August Bloch. An illustrated description of the design and construction of these machines. 3600 w. Elektrotech u Maschinenbau—Feb. 2, 1908. No. 90963 D.

The Cascade Converter. Abstract translation of an article by Herr A. Bloch in *Elektrotechnik und Maschinenbau.* Illustrated description of this machine and its operation. 1400 w. Elec Engr, Lond—March 6, 1908. No. 90889 A.

Substations.

See Berlin, under STREET AND ELECTRIC RAILWAYS.

Systems.

The Central Station Distributing System. H. B. Gear and P. F. Williams. Reviews critically the various general types of distributing systems which have come into use. 4000 w. Elec Age—Feb., 1908. No. 90725.

Transformers.

Current Rushes at Switching. J. S. Peck. An explanation of the phenomena. 1500 w. Elec Jour—March, 1908. No. 90797.

MISCELLANY.

Electric Fans.

Comparative Tests of Different Types of Electric Fans. Arthur C. Scott. An outline description and report of tests made of seven fans, three built to operate with direct current and four with alternating current. 2000 w. Elec Wld—March 7, 1908. No. 90727.

Farm Work.

Electric Power for Farm Work. Reprints an article by Jared Van Wagenen, published in the *Rural New-Yorker,* describing a method employed for utilizing a small water power to generate electricity for lighting and power purposes. Also editorial. 2500 w. Elec Rev, N Y—March 28, 1908. No. 91188.

Nomenclature.

Engineering Nomenclature. Robert H. Smith. Briefly considers algebraic symbolism, uniform technical names, and simple short names for the units, giving a list of such proposed names. 2000 w. Elec Engr, Lond—March 13, 1908. No. 91133 A.

INDUSTRIAL ECONOMY

Education.

The Influence of Technical Schools. John J. Stevenson. Discusses the aims of schools of applied science and the aims of classical studies. 2500 w. Pop Sci M—March, 1908. No. 90817 C.

A Comparison of University and Industrial Methods and Discipline. Frederick W. Taylor. Discusses the preparation of young men for success in commercial engineering and industrial enterprises. 3300 w. Wis Engr—Feb., 1908. No. 91225 D.

Notes on Four Years' Working of the Educational Committee's Recommendations. W. G. Spence. On the results of adopting a system of marking for recording the time keeping, industry, and evening study of apprentices. Discussion. 9000 w. Trans N-E Coast Inst of Engrs & Shpbldrs—Feb., 1908. No. 91244 N.

The Development of Higher Technical Education in Germany (Desarrollo de la Enseñanza Téchnica Superior en Alemania). Alvaro Llatas. A review of past and present conditions. Ills. 11500 w. Rivista Tech Indus—Jan., 1908. No. 90929 D.

The Practical Workshop Training of the Academic Mechanical Engineer (Die praktische Werkstattausbildung der akademischen Maschineningenieure). F. zur Nedden. A discussion of German and American methods in engineering apprenticeship courses. 5000 w. Zeitschr d Ver Deutscher Ing—Feb. 1, 1908. No. 90980 D.

Eight-Hour Day.

Eight Hours' Day in Coal Mines. Comments on the first report of the Departmental Committee appointed to inquire

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into the probable economic effect of a limit of eight hours to the working day of coal miners, and on other works on this subject. 6500 w. Quarterly Rev—Jan., 1908. No. 91071 N.

Filing Systems.

Loose-Leaf Binders. J. H. Haertier. Explains methods of recording data in regard to the progress and cost of work, and of filing general information. 4800 w. Mines & Min—March, 1908. No. 90676 C.

Industrial Classification.

The Classification of Industrial Enterprises. William D. Ennis. An analytical study of various industries showing that the relation of costs to values of output gives the most satisfactory basis. 5400 w. Stevens Ind—Jan., 1908. No. 91194 D.

Labor.

American Industrial Conditions from a Workman's Viewpoint. A commentary by a New England machinist on Dr. Louis Bell's article "Wake Up America." 1300 w. Engineering Magazine—April, 1908. No. 91235 B.

Labor Insurance.

Workmen's Sick Funds and Insurance (Krankenkassen und Krankenfürsorge). Moritz Böker. A discussion of conditions in Germany. 4300 w. Stahl u Eisen—Feb. 26, 1908. No. 90935 D.

Management.

A Simple and Complete Draftingroom System. William F. Zimmermann. Illustrates and describes a system used in a Newark, N. J., plant. 4500 w. Am Mach—Vol. 31, No. 11. No. 90780.

The Rapid Handling of a Large Payroll. George Frederic Stratton. Describes method by which 11,000 employes are paid off in 20 minutes. 2200 w. Am Mach—Vol. 31, No. 10. No. 90689.

The General Shop Order (Die Generalstückliste). C. Redtmann. Illustrates and describes a shop-order form, explaining the importance of the system. 2000 w. Zeitschr f Werkzeug—Feb. 5, 1908. No. 90948 D.

Effective Machine-Shop Organization. Alexander Taylor. Describes the plan of reorganization of the Westinghouse Elec. & Mfg. Co. 1700 w. Am Mach—Vol. 31, No. 12. No. 91008.

Tracing the Work Through the Shop. Oscar E. Perrigo. Sixth of a series of articles on shop management and cost keeping. Gives the plan used in a shop making a variety of gears. 2500 w. Ir Trd Rev—March 5, 1908. No. 90711.

The Regeneration of the Old Shop. An illustrated article describing the abandonment of old methods and specializing in the manufacture of wood-working machinery. 2000 w. Am Mach—Vol. 31, No. 10 No. 90686.

Cost Reduction for Manufacturing Plants. Maurice Gesundheit. Read before the Metal Mfrs. Assn. of Phila. Discusses the various measures resorted to for reducing costs and their defects, suggesting a remedy. 5000 w. Eng News—March 5, 1908. No. 90693.

Maximum Production Through Organization and Supervision. C. E. Knoeppel. This first of a series of four articles discussing the adjustment of organization to secure the greatest efficiency. 3500 w. Engineering Magazine—April, 1908. Serial 1st part. No. 91234 B.

The Fundamental Principles of Works Organization and Management. P. J. Darlington. This second article on this subject deals with developing new product and determining shop cost. 4500 w. Engineering Magazine—April, 1908. No. 91232 B.

See also Profit Sharing, Purchasing, and Wages, under INDUSTRIAL ECONOMY.

Municipal Control.

The Municipality and the Public Utilities. Hubert S. Wynkoop. Gives briefly the writer's views on the control and regulation of public utilities by municipalities. 1200 w. Stevens Ind—Jan., 1908. No. 91195 D.

Patents.

The New British Patent Act. George Barker. An abstract of the more important provisions of the new act. 1500 w. Cassier's Mag—March, 1908. No. 90826 B.

Does the Inventor Get a Square Deal at the Hands of the United States Government? H. Ward Leonard. A criticism of the working of the United States patent system, with editorial. Also article by Joseph B. Baker on "Salaries of Patent Office Examiners." 5000 w. Elec Wld—March 14, 1908. No. 90786.

Profit Sharing.

Profit Sharing. A Wilson. An explanation of how such a system may be applied and its advantages. 2800 w. Cassier's Mag—March, 1908. No. 90823 B.

Purchasing.

A Complete System for the Purchasing Department. J Cecil Nuckols. Deals with methods and records necessary to intelligent buying, giving forms. 1500 w. Engineering Magazine—April, 1908. No. 91230 B.

Wages.

The Payment of Wages. Forrest E. Cordullo. Discusses the three systems in general use, their defects and virtues; also the requirements of the best system, and the system called the "Diminishing Premium System." 5000 w. Ir Trd Rev—March 19, 1908. No. 91034.

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MARINE AND NAVAL ENGINEERING

Battleships.

On the Size of Battleships. Sidney Graves Koon. A comparative analysis showing the great sacrifice in efficiency where the size is reduced. 2000 w. Engineering Magazine—April, 1908. No. 91229 B.

A Review of All the Battleships Built During the Last Twenty Years and All the Armored Cruisers Built During the Last Fifteen Years, by the Eight Great Sea Powers (Uebersicht über alle in den letzten zwanzig Jahren abgelaufenen Linienschiffe und über alle in den letzten fünfzehn Jahren abgelaufenen Panzerkreuzer der acht grössten Seestaaten). Franz Eisenhardt. Gives statistics year by year. 3500 w. Schiffbau—Feb. 12, 1908. No. 90955 D.

Cruisers.

See Battleships, under MARINE AND NAVAL ENGINEERING.

Dredges.

See Dredging, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Dry Docks.

A New Method of Pumping Floating Dry Docks. William T. Donnelly. An illustrated explanation of the operation of the system and details of construction, stating the advantages claimed. Discussion. 10500 w. Pro Brooklyn Engrs' Club, No. 76—Vol. XI, 1907. No. 91240 N.

American Docking Facilities on the Pacific Coast. H. A. Crafts. A review of the dry-dock facilities showing their inadequacy for keeping the vessels of Admiral Evans' fleet in first-class condition while in Pacific waters. 2500 w. Cassier's Mag—March, 1908. No. 90822 B.

Floating Docks (Zur Frage der Schwimmdocks). O. Flamm. Describes various types and discusses their design. Ills. 3000 w. Schiffbau—Feb. 26, 1908. No. 90952 D.

The Floating Dock of the Compagnie Générale de Navigation on Lake Léman at Ouchy (Dock Flottant de la Compagnie Générale de Navigation sur le Lac Léman à Ouchy). J. Michaud. Illustrated description of a dock for lifting 400-ton ships. 1800 w. Serial, 1st part. Bul Tech de la Suisse Romande—Feb. 25, 1908. No. 90915 D.

Ferryboats.

New Western River Car Transfer Paddle Ferryboat Albatross. Illustrated detailed description of a steel hull sidewheel boat for transferring cars between Vicksburg and the Delta on the Mississippi River. 1600 w. Naut Gaz—March 5, 1908. No. 90674.

Gyrostats.

The Use of Gyrostats. An explanation by Prof. Perry of what inventors using gyrostats have succeeded in doing, especially considering their application to reducing the rolling of ships and to the monorail railway. Ills. 3800 w. Nature—March 12, 1908. No. 91122 A.

Internal-Combustion Engines.

See Motor Boats, and Oil Engines, under MARINE AND NAVAL ENGINEERING.

Marine Transport.

Transportation on the Great Lakes. Walter Thayer. Describes the origin, character, and method of handling the tonnage of the Great Lakes. 5500 w. Naut Gaz—March 12, 1908. No. 90779.

Motor Boats.

Motor Boating for the Man of Small Means. Harry Wilkin Perry. An illustrated article giving information in regard to the application of motors to canoes and small boats. 3000 w. Sci Am—Feb. 29, 1908. No. 90599.

Inland Motor Boating. H. R. de Salis. Abstract of a paper on "Pleasure Cruises for Motor Boats on the Inland Navigations of England and Wales," read before the Motor Yacht Club. Concerning the conditions of travelling, and related matters. 3500 w. Auto Jour—Feb. 29, 1908. Serial, 1st part. No. 90757 A.

The Racing Motor-Launch "Siddeley-Wolseley." Illustrated detailed description of a boat to be entered at the Monte Carlo races. 1000 w. Engng—Feb. 21, 1908. No. 90668 A.

Motor-Pinnace for the Royal Navy. Illustrations and brief description of a boat originally equipped with steam machinery, showing the saving in space resulting from the change to internal-combustion engines. 500 w. Engng—March 13, 1908. No. 91141 A.

Oil Engines.

Thornycroft Paraffin Engines for the Italian Navy. Illustrates and describes these marine engines. 1800 w. Auto Jour—Feb. 22, 1908. Serial, 1st part. No. 90649 A.

Diesel Oil Engines for Ship Propulsion. Franz Erich Junge. Gives results of test of the latest type of high-speed Diesel engine, built especially for marine service. Ills. 2500 w. Power—March 24, 1908. No. 91113.

Shipbuilding.

Shipbuilding in 1907 (Der Schiffbau im Jahre 1907). F. Meyer and H. Dörwaldt. The first number of the serial gives detailed statistics for Germany. 4000 w. Serial, 1st part. Schiffbau—Feb. 26, 1908. No. 90954 D.

Steamboats.

The Fast Steamer Florida. George Jenkins and A. E. Woodruff. Illustrated

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description of a fine new vessel for service between Baltimore and Norfolk. 1200 w. Int Marine Engng—April, 1908. No. 91104 C.

Steam Boilers.

Some Remarks on the Design, Construction and Working of the Marine Boiler. Richard Hirst. Gives opinions on prevailing practice. 3500 w. Boiler Maker—April, 1908. No. 91245.

Steam Engines.

See Steam Turbines, under MARINE AND NAVAL ENGINEERING; and Lubricants, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Steamships.

Steam Lumber Schooners for the Pacific Coast. Illustrated detailed description of two vessels of unique design for this service. 2000 w. Int Marine Engng—April, 1908. No. 91106 C.

Recent Freight Steamship Designs. Illustrations, with brief descriptions of two recent vessels—the "Echunga" and a freighter for the Norwegian trade. 1000 w. Sci Am Sup—March 28, 1908. No. 91180.

The Argo Liner "Schwan" (Der Argo-Dampfer "Schwan"). Franz Judaschke. Illustrated description of this vessel for service between Bremen and London. 1600 w. Schiffbau—Feb. 26, 1908. No. 90953 D.

Steam Turbines.

Turbines versus the Reciprocating Engine for Marine Purposes. Ferdinand La-Motte Gilpin, Jr. Calls attention to the advantages of turbines. 1800 w. Yale Sci M—March, 1908. No. 91040 C.

Submarines.

The Relation of the Government to the Development of Submarine Vessels. Letter from R. G. Skerrett, making statements relating to the United States government and its relation to the Holland Company experiments. 2500 w. Sci Am Sup—March 21, 1908. Serial. 1st part. No. 91024.

Warships.

The Relative Values of Warships. C. T. Brady, Jr. Derives a formula used by the writer for comparison of ships. Also editorial criticism. 1300 w. Int Marine Engng—April, 1908. No. 91105 C.

MECHANICAL ENGINEERING

AUTOMOBILES.

Commercial Vehicles.

See Electric, Omnibuses, and Road Trains, under AUTOMOBILES.

Construction.

The Bracing of Motor-Car Frames. Discusses prevailing practice in the bracing of pressed-steel frames, the stresses, etc. 2500 w. Engng—Feb. 21, 1908. No. 90665 A.

See also Ball Bearings, under MACHINE ELEMENTS AND DESIGN; and Alloy Steels, under MATERIALS OF CONSTRUCTION.

Crankshafts.

Design and Construction of Crankshafts. P. M. Heldt. Read before the Soc. of Auto. Engrs. at Boston. Illustrates and describes crankshafts of 1907 and 1908 models of American four-cylinder engines, showing a considerable variety in design, and discusses their requisites, design, materials, etc. 3300 w. Automobile—March 19, 1908. No. 91073.

Design.

The Design of the Automobile and Some Problems Peculiar to It. F. W. Lanchester. Read before the Inst. of Auto Engrs. Deals with suspension; dynamical effects in control mechanism; worm driving and screw propulsion; and gyroscopic effects. Ills. 7000 w. Autocar—March 14, 1908. Serial. 1st part. No. 91127 A.

Electric.

Electric Vans, 'Buses and Cabs. Discusses the prospects of electric commercial vehicles. 4000 w. Auto Jour—March 14, 1908. Serial. 1st part. No. 91126 A.

Electricity in the Transmissions of Petrol Vehicles (L'Electricité dans les Transmissions des Voitures à Pétrole). M. Gasnier. Describes various types of electric clutches and speed-changing devices. Ills. 11000 w. Bul Soc Int des Elec'ns—Feb., 1908. No. 90905 F.

Electric Automobiles at the Berlin Exhibition, 1907 (Die Elektromobile auf der Berliner Ausstellung, 1907). K. Schirmbeck. Describes the exhibits briefly and discusses the tendencies in design manifested. 4000 w. Serial, 1st part. Zeitschr d Mit Motorwagen Ver—Feb. 15, 1908. No. 90962 D.

See also Road Trains, under AUTOMOBILES.

Farm Motors.

The Gasoline Motor in Farm Development. George Ethelbert Walsh. An account of the extensive use being made of the gasoline motor in farming, and the saving effected. 2500 w. Cassier's Mag—March, 1908. No. 90820 B.

Fuels.

See Producer Gas, under AUTOMOBILES.

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Ignition.

The Perfection of Automobile Ignition. J. O. Heinze. Read before the Soc. of Auto. Engrs. at N. Y. Considers present-day electrical ignition and the systems employed, their construction and efficiency. Ills. 3000 w. Automobile—March 12, 1908. No. 90812.

Light Cars.

The Development of the "Light Car" (Die Entwicklung des "Kleinen Wagens"). A. Bursch and J. Küster. Discusses the growing use of light, low-powered cars and describes many types. Ills. 1800 w. Serial. 1st part. Zeitschr d Mit Motorwagen Ver—Feb. 15, 1908. No. 90961 D.

Lubrication.

The Rationale of Lubrication. J. W. Frings. The present number discusses mainly the quality and quantity of the oil used. Ills. 2000 w. Motor Car Jour—Feb. 22, 1908. Serial. 1st part. No. 90646 A.

Omnibuses.

New York and Philadelphia Motor Buses. Harry W. Perry. An illustrated description of the gasoline and electric automobiles used in these cities. 2200 w. Sci Am Sup—March 28, 1908. No. 91179.

Producer Gas.

A Producer Gas Motor Car. Gives particulars concerning the adaptation of this source of power to motor car work. Ills. 1500 w. Prac Engr—March 6, 1908. No. 90883 A.

Renault.

Features of Renault Six-Cylinder Chassis. Illustrated description of the ignition system, self-starter, and other features. 1500 w. Automobile—March 12, 1908. No. 90813.

Road Trains.

The Sampson Gas-Electric Road Train. Harry W. Perry. Illustrated description of this novel tractor and trailers for transportation. 2000 w. Sci Am Sup—Feb. 22, 1908. No. 90590.

Multiple Unit Systems of Transportation. Joseph A. Anglada. Read before the Soc of Auto. Engrs, at Boston. An illustrated article discussing briefly the objections to large trucks, and the various systems of road trains. 2300 w. Automobile—March 26, 1908. No. 91184.

Steering.

Gyrostatic Action—Its Effect on Steering. William W. Watson. Read before the Royal Auto. Club, London. Brief explanation of the action and a study of its effects on the automobile. 1200 w. Automobile—March 26, 1908. No. 91185.

Testing.

Automobile Club of America's Motor Car Testing Plant. Harold Whiting Slauson. Describes briefly the equipment and the method of testing. 1500 w. Sib Jour of Engng—March, 1908. No. 91-070 C.

Troubles.

Motor Troubles and How to Overcome Them. Arthur H. Denison. Discusses some common troubles and their causes, giving accounts of some troubles that cannot be traced. 2000 w. Automobile—March 19, 1908. No. 91074.

Vauxhall.

The 12-16-H.P. Vauxhall Car. Illustrated detailed description. 1600 w. Auto Jour—Feb. 22, 1908. Serial. 1st part. No. 90647 A.

Vulcan.

The 14-H.P. Vulcan Car. Drawings and description. 1600 w. Autocar—Feb. 22, 1908. No. 90650 A.

COMBUSTION MOTORS.

Fuels.

Acetylene, Alcohol, and Power. T. L. White. Read before the Int. Acetylene Assn. Considers the possibilities of acetylene as a motor fuel. 1500 w. Sci Am Sup—Feb. 15, 1908. No. 90583.

Tests of Gasoline and Kerosene Engines with Alcohol Fuel. S. M. Woodward. Description, condensed from Bul. 191 of the Office of Experiment Stations, of investigations carried out by the U. S. Dept. of Agriculture, upon the availability of alcohol as an engine fuel. Ills. 5500 w. Eng News—March 12, 1908. No. 90788.

Gas Engines.

Some Possible Developments of the Gas-Engine. Editorial review of recent paper by Prof. S. A. Reeve. 1200 w. Engng—Feb. 21, 1908. No. 90669 A.

Standard Designs and Construction of Large Gas Engines. F. E. Junge. A discussion limited to types that have given continuous service under severe conditions. Ills. 3500 w. Ir Trd Rev—March 26, 1908. Serial. 1st part. No. 91197.

Gas Engine Installations at Buenos Ayres. Two interesting installations of producers and gas engines are illustrated and described. 2500 w. Eng Rec—March 7, 1908. No. 90707.

See also Ignition, under COMBUSTION MOTORS; Engine Design, under STEAM ENGINEERING; and Water Works, under CIVIL ENGINEERING, WATER SUPPLY.

Gasoline Engines.

An Odorless Gasoline Motor. From the *Engineering Times*. Describes a new three-cycle engine. 3500 w. Sci Am Sup—Feb. 8, 1908. No. 90581.

See also Farm Motors, under AUTOMOBILES; and Fuels, under COMBUSTION MOTORS.

Gas Power Plants.

A Modern Power Plant for Railway

We supply copies of these articles. See page 322.

Shop Service. A producer gas plant to furnish power for the main car repair shops at Minneapolis is illustrated and described. 2000 w. Engr, U S A—March 2, 1908. No. 90622 C.

Ignition.

Ignition for Large Gas Engines. Illustrated description of the system of ignition invented by Sir Oliver Lodge, the characteristic feature being the use of a spark from a Leyden jar. 1000 w. Engr, Lond—Feb. 28, 1908. No. 90777 A.

The Speed of Ignition of Explosive Gas Mixtures (Versuche über die Zündgeschwindigkeit explosibler Gasgemische). A. Nägel. Describes and gives results of tests on various mixtures. Ills. 6600 w. Zeitschr d Ver Deutscher Ing—Feb. 15, 1908. No. 90977 D.

Light Motors.

The Extra-Light Internal-Combustion Motor (Moteur Extra-Léger à Explosion). M. R. Esnault-Pelterie. A theoretical discussion of the principles on which very light motors must be designed, materials, cylinders, etc. Ills. 10000 w. Mem Soc Ing Civ de France—Dec., 1907. No. 90902 G.

Oil Engines.

Tests of a High-Speed Diesel Motor (Versuche an einem raschlaufenden Dieselmotor). Chr. Eberle. Illustrated description of methods and results of tests on a 300 horse-power motor. Ills. 3800 w. Zeitschr d Ver Deutscher Ing—Feb. 1, 1908. No. 90981 D.

Test of the 200 Horse-Power Diesel Motor in the electric plant of the L. v. Rollschen Ironworks (Untersuchung des 200 PS Dieselmotors mit Schwungraddynamo in der elektrischen Zentrale der L. v. Rollschen Eisenwerke, Giesserei Bern). Gustav Weber. Describes and gives results of tests of this engine which is direct connected to a direct-current dynamo. Ills. 2000 w. Schweiz Bau—Feb. 1, 1908. No. 90946 D.

See also Fuels, under COMBUSTION MOTORS; and Oil Engines, under MARINE AND NAVAL ENGINEERING.

Producer Gas.

See same title, under AUTOMOBILES.

HEATING AND COOLING.

Air Liquefaction.

Place's Air-Liquefying Expansion Engine. J. F. Place. An illustrated description of the engine installed at Norwich, Conn., and of its air liquefying apparatus, giving indicator cards taken at the time of testing. 3500 w. Compressed Air—March, 1908. No. 90794.

Central Plants.

The Calculation of Central Heating Plants (Ueber die Kalkulation von Zentralheizanlagen). Fritz Janeck. Refers especially to the cost of repairs and alterations. 8800 w. Gesundheits-Ing—Feb. 1, 1908. No. 90970 D.

Electric Heating.

Electric Heating at Biltmore, N. C. Illustrated description of arrangements for heating water and laundry equipment by electricity. 1600 w. Met Work—March 7, 1908. No. 90720.

Fans.

The Operation of Screw Disc Ventilators (Ueber die Wirkungsweise von Schraubenventilatoren). Leopold Nowotny. A mathematical discussion of their efficiency and output when electrically driven. Ills. 2000 w. Oest Zeitschr f d Oeffent Baudienst—Feb. 22, 1908. No. 90974 D.

Hot-Air Heating.

Air Velocity in Furnace Heating. Konrad Konrad. Diagram and explanation of the fundamental principles of a furnace system of heating. 2500 w. Met Work—Feb. 29, 1908. No. 90580.

Some Comments on Heating. A. K. Campbell. Inspired through an historical account of heating from Roman times, read by Hermann Vetter, at Vienna. 3000 w. Met Work—March 7, 1908. No. 90721.

Refrigeration.

Mechanical Refrigeration in a Horticultural Establishment. Illustrated description of a cold storage plant for cut flowers and bulbs at Morton Grove, Ill. 2000 w. Engr, U S A—March 16, 1908. No. 90858 C.

See also Electric Driving, under POWER AND TRANSMISSION.

Regulation.

Distant Measuring and Regulating Devices in Heating and Ventilating Plants (Fernmess- und Fernstellvorrichtungen im Dienste der Heizungs- und Lüftungsanlagen). H. Recknagel. Illustrated description of various instruments for the distant measurement and control of temperature. 4400 w. Gesundheits-Ing—Feb. 8, 1908. No. 90971 D.

Steam Heating.

Modern Steam Heating Illustrated. B. F. Raber. The first of a series of illustrated articles discussing the various systems of steam heating. 1800 w. Dom Engng—March 7, 1908. No. 90738.

Heating and Ventilation of the Madison Square Presbyterian Church, New York. Illustrated detailed descriptions of independent systems. The heating is by direct radiation on the two-pipe system with the Webster vacuum system of returns. Ventilation is applied on the downward plenum system. 4500 w. Eng Rec—March 14, 1908. No. 90840.

Ventilation.

Amount of Air Needed for Ventilation.

We supply copies of these articles. See page 322.

F. H. Bryant. Abstracted from the *Architect and Engineer*. Gives a few practical hints. 1200 w. Sci Am Sup—Feb. 22, 1908. No. 90587.

The Operation of a Modern Heating and Ventilating System. Information and instructions on the heating and ventilation of the New York City public schools. Ills. 5600 w. Heat & Vent Mag—March, 1908. No. 91062.

Warming and Ventilation. W. H. Casmey. From a second prize paper read before the British Inst. of Heat. & Vent. Engrs. Deals especially with the importance of ventilation and the features of mechanical systems. 1500 w. Heat & Vent Mag—March, 1908. No. 91063.

See also Steam Heating, under HEATING AND COOLING; and Subway Ventilation, under STREET AND ELECTRIC RAILWAYS.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

Centrifugal Pumps. E. F. Doty. Describes pumps adapted for irrigation, mine service and hydraulic dredging. 1800 w. Engr, U S A—March 2, 1908. No. 90624 C.

High-Pressure Centrifugal Pumps (Ueber Hochdruck-Zentrifugalpumpen). Donat Banki. A mathematical discussion, illustrating several types. 2000 w. Serial, 1st part. Zeitschr d Oest Ing u Arch Ver—Feb. 21, 1908. No. 90967 D.

Electric Pumping.

See Pumping Plants, under HYDRAULIC MACHINERY; and Fire Protection, under CIVIL ENGINEERING, WATER SUPPLY.

Pumping.

See Dry Docks, under MARINE AND NAVAL ENGINEERING.

Pumping Plants.

Electrically Operated Automatic Sewage Pumping Station at Waltham, Mass. Illustrated description of an isolated plant. 1000 w. Eng Rec—March, 1908. No. 90706.

See also Water Works, under CIVIL ENGINEERING, WATER SUPPLY; Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS; and Pumping, under MINING AND METALLURGY, MINING.

Turbines.

A High-Head Reaction Turbine Installation. Illustrated description of an installation recently put in service at Centerville, Cal. 2500 w. Eng Rec—March 21, 1908. No. 91078.

The Highest Head Francis Turbine: Centerville Hydro-Electric Power Installation of the California Gas and Electric Corporation. James H. Wise. Read before the San Francisco Assn. of the Am. Soc. of Civ. Engrs. An illustrated description of the plant. 4000 w. Eng News—March 19, 1908. No. 91021.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Automobile Hub Ball Bearings. Henry Hess. Read before the Soc. of Auto. Engrs. An account of experiments to determine the behavior of ball bearings as used in an automobile hub under proper and improper conditions. 1700 w. Automobile—March 5, 1908. No. 90712.

Curved Parts.

The Design of Curved Rods (Berechnung von gekrümmten Stäben). A. Baumann. A mathematical paper on the design of curved machine parts. Ills. 7000 w. Serial, 1st part. Zeitschr d Ver Deutscher Ing—Feb. 29, 1908. No. 90979 D.

Drafting.

See Management, under INDUSTRIAL ECONOMY.

Gears.

The Design of Gears (Calcul des Engrenages). Clément Renders-Parent. A discussion of the calculation of bevel and spur gears. Ills. 2500 w. All Indus—Feb., 1908. No. 90918 D.

Kinematics.

The Mutual Relations of Geometry and Mechanics and Prof. Reuleaux's Mechanical Movements. Dr. Alfred Gradenwitz. An illustrated article explaining the principle of Reuleaux's theoretical kinematics, demonstrating the laws of guided motion. 2200 w. Sci Am—March 21, 1908. No. 91023.

Speed Changing.

The Theory and Design of the Ruppert Speed Changing Gear (Theorie und Berechnung der Ruppertschen Wechselräder-Getriebe). Victor Fischer. An illustrated mathematical discussion. 3000 w. Zeitschr f Werkzeug—Feb. 15, 1908. No. 90949 D.

Stresses.

Maximum Stresses. John S. Myers. Presents cases of variable and of combined stresses, showing the manner of obtaining the maximum stress for which the part should be designed. 3000 w. Mach, N Y—March, 1908. No. 90638 C.

MACHINE WORKS AND FOUNDRIES.

Annealing.

Annealing Tubes and Gas-Bottles. Walter J. May. Brief suggestions for annealing effectively. 800 w. Prac Engr—March 13, 1908. No. 91137 A.

Boiler Making.

Estimating the Cost of Repair Work. James Crombie. Gives method of estimating for several repair jobs on boilers. 2500 w. Boiler Maker—March, 1908. No. 90634.

Estimating the Cost of a Small Scotch Boiler. James Crombie. Gives the dimensions and working pressure of the boiler considered, with an estimate of the cost. 2000 w. Boiler Maker—April, 1908. No. 91246.

Boring.

Boring Bars for Turbine Castings. T. M. Lowthian. Illustrates and describes a tool used in building Parsons turbines. 1000 w. Am Mach—Vol. 31, No. 13. No. 91167.

Castings.

Malleable Iron Castings. P. I. Giron. Calls attention to errors with regard to this material in the present number. 1000 w. Prac Engr—Feb. 21, 1908. Serial, 1st part. No. 90658 A.

Cupola Charging.

Charging Machines for Cupolas. G. R. Brandon. Read before the Pittsburg Found. Assn. Illustrates and describes successful and practical machines. 1500 w. Ir Trd Rev—March 12, 1908. No. 90809.

Dies.

See Screw Machines, under MACHINE WORKS AND FOUNDRIES.

Drilling Machines.

A Multiple-Spindle Sub-Drill. F. H. Stead. Illustrates and describes a sub-drill used in connection with a single-spindle Davis drill. 800 w. Am Mach—Vol. 31, No. 12. No. 91009.

Foundries.

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

Foundry Practice.

Making Low-Priced Machines. Walter J. May. Abstracted from the *English Mechanic*. Suggestions for turning out work well and cheaply in the foundry. Ills. 2000 w. Sci Am Sup—Feb. 15, 1908. No. 90584.

Foundry Waste. Dr. Richard Moldenke. Read before the Chicago Found. Foremen's Assn. Points out needless waste in castings, iron, molding sand, etc. 2200 w. Ir Age—March 12, 1908. No. 90783.

See also Annealing, Castings, and Moldings, under MACHINE WORKS AND FOUNDRIES.

Gear Cutting.

Hobbing Bevel Gears with a Taper Hob. E. Gregory. Illustrates and describes a new principle in gear hobbing. 1000 w. Am Mach—Vol. 31, No. 10. No. 90688.

Machine-Cut Double Helical Wheels. Illustrated description of wheels that are practically noiseless and satisfactory in every way. 1700 w. Engng—Feb. 21, 1908. No. 90667 A.

Grinding.

The Time Required for Machine Work. Fred H. Colvin. Gives examples of automatic screw-machine work that help in estimating. 1000 w. Am Mach—Vol. 31, No. 12. Serial, 1st part. No. 91011.

Grinding vs. Cutting by Emery Wheels. C. H. Norton. A comparison of conditions, power speeds and time necessary to remove metal by grinding under normal and abnormal conditions. 1800 w. Am Mach—Vol. 31, No. 13. No. 91163.

Grinding Machines.

Notes on the Use of Grinding-Machines. J. E. Livermore. Discusses this machine and its uses. 5000 w. Engng—March 6, 1908. No. 91000 A.

Jigs.

See Shop Appliances, under MACHINE WORKS AND FOUNDRIES.

Lathes.

The Automatic vs. the Hand Lathe. W. Conrad. Gives evidence in proof of the money-saving qualities of the automatic. Ills. 1800 w. Am Mach—Vol. 31, No. 12. No. 91012.

Special Lathe and Tool Equipment for Turning Cone Pulleys. Line engravings and illustrations, with description of the construction and operation of this machine and the tools used with it. 1300 w. Mach, N Y—March, 1908. No. 90664 C.

Milling Machines.

Purchasing Milling Machines by Power. P. V. Vernon. An argument for making horse-power the determining factor, rather than mere weight. 2000 w. Engr, Lond—March 13, 1908. No. 91144 A.

Molding.

Molding Drums for Hoisting Engines. Joseph F. Hart. Illustrates and describes types of drums and the rigging for molding them. 800 w. Am Mach—Vol. 31, No. 12. No. 91013.

Planing Machines.

Some Planing Machine History. T. R. Shaw. Reviews the history and development of the metal planing machine. 3000 w. Mech Engr—March 6, 1908. Serial, 1st part. No. 90887 A.

Pneumatic Tools.

M. Baril's Pneumatic Hammer (Sur un Frappeur Pneumatique de M. Baril). M. E. Sauvage. Illustrated detailed description. 1750 w. Bul Soc d'Encour—Jan., 1908. No. 90908 G.

Safety Appliances.

See Textile Machinery, under MISCELLANY.

Saws.

The Action of Toothless Circular Saws. F. W. Harbord. Micro-photographs and explanation of what they show. 900 w. Engr, Lond—Feb. 21, 1908. No. 90671 A.

Screw Machines.

Dies and Taps for Automatic Screw Machines. C. L. Goodrich and F. A. Stanley. An illustrated article dealing

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with spring and button dies, and various kinds of taps. 4000 w. Am Mach—Vol. 31, No. 11. No. 90781.

See also Grinding, under MACHINE WORKS AND FOUNDRIES.

Shop Appliances.

Cat Head for Connecting-rod Ends. L. E. Salmon. Illustrated description. 800 w. Am Mach—Vol. 31, No. 13. No. 91166.

A Slotting Attachment for Small Holes. George Bilham. Brief illustrated description. 600 w. Am Mach—Vol. 31, No. 13. No. 91165.

Jigs and Fixtures in the Pratt & Whitney Co.'s Shops. Illustrated descriptions of special tools. 3000 w. Mach, N Y—March, 1908. No. 90639 C.

Shop Practice.

Machining a Street-Car Motor Frame. P. Fenaux. Describes the operations performed and the tools and fixtures used. Ills. 2500 w. Am Mach—Vol. 31, No. 11. No. 90782.

Making a Novel Gun-Barrel Mandrel. Eugene C. Peck. Describes the method used for very accurate work. Ills. 1000 w. Am Mach—Vol. 31, No. 12. No. 91014.

Shops.

The Ball Engine Works at Erie, Pa. Illustrated detailed description. 2500 w. Ir Trd Rev—March 5, 1908. No. 90710.

Stockport Gas Engine Works. Brief review of the history, describing the works and methods. Ills. 3500 w. Engr, Lond—March 13, 1908. No. 91145 A.

Spittlegate Iron Works, Grantham. Illustrated description of works for the manufacture of agricultural implements, with brief review of their history. 4800 w. Engr, Lond—March 6, 1908. No. 91005 A.

The New Works of Hans Renold, Limited. J. W. Carrel. Line engraving and half-tones, with description of this electrically driven plant. 1200 w. Am Mach—Vol. 31, No. 12. No. 91010.

The Boiler Shop of the Harlan & Hollingsworth Corporation. Charles S. Linch. Illustrated description of a modern shop at Wilmington, Del., and its equipment. 1800 w. Boiler Maker—March, 1908. No. 90633.

The Skoda Works, Pilsen. Historical review of the development and illustrated detailed description of the works in Austria. They combine the manufacture of steel with the construction of ordnance and artillery, and with engineering in all its branches. Plates. 5000 w. Engng—March 6, 1908. No. 91001 A.

The Arrangement and Construction of a Modern Manufacturing Plant. Thomas C. Flinn. Illustrated detailed description of the construction of the new plant of the Kennedy Valve Mfg. Co., at Elmira, N. Y. Discussion. 4000 w. Pro Brooklyn Engrs' Club, No. 77—Vol. XI, 1907. No. 91241 N.

Taps.

Taper Taps. Erik Oberg. Considers points of importance in making taper taps. Ills. 2800 w. Mach, N. Y.—March, 1908. Serial. 1st part. No. 90640 C.

See also Screw Machines, under MACHINE WORKS AND FOUNDRIES.

MATERIALS OF CONSTRUCTION.

Alloys.

Alloys Resisting the Action of Acids, Dilute or Concentrated, Hot, Cold or in the State of Vapor (Les Métillures, Alliages Resistant aux Acides Etendus ou Concentrés, Froids, Chauds ou à l'Etat de Vapeurs). M. Ad. Jouve. Discusses investigations of iron-silicon alloys for use in the chemical industries. 3000 w. Mem Soc Ing Civ de France—Dec., 1907. No. 90903 G.

Alloy Steels.

Manganese Steel (L'Acier au Manganèse). A discussion of its properties and applications. Ills. 2000 w. Génie Civil—Feb. 22, 1908. No. 90925 D.

The Special Steels at the Salon de l'Automobile (Les Aciers Spéciaux au Salon de l'Automobile). M. Louis Révillon. A review of recent advances in steels for automobile construction giving details in curves and tables. Ills. 5000 w. Rev de Metal—Feb., 1908. No. 90906 E + F.

Bearing Metals.

A New Bearing Metal. Lothar Sempell. Information on a new bearing alloy from investigations published by G. Renine. 1800 w. Power—March 24, 1908. No. 91110.

Metallography.

Researches on the Gas Contained in Metals (Recherches sur les Gaz Contenu dans les Métaux). M. O. Boudouard. The results of researches on the conditions of extraction of occluded gases. 2500 w. Rev de Métal—Feb., 1908. No. 90907 E + F.

Steel

Steel Differences. J. Kent Smith. Considers some of the causes of difference. 1200 w. Ir Age—March 26, 1908. No. 91162.

Steel and Its Uses. Edmund F. Lake. Illustrates and describes furnaces for converting iron into steel and discusses ingredients and materials used; heat treatment, hardening, tempering, carbonizing; properties; working, forging, welding and machining. 41500 w. Am Mach—Vol. 31, No. 13. No. 91168.

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Notes on the Effect of Work and Time on the Properties of Mild Steel and Iron. John H. Heck. Gives results of tests made on material for the construction of vessels and machinery, and also tests of old steel which had been used for a number of years, discussing the quality. Discussion. Ills. 13000 w. Trans N-E Coast Inst of Engrs & Shipbldrs—Feb., 1908. Parts I & II. No. 91243 N.

MEASUREMENT.

Anemometers.

An Indicating Anemometer and Wind Direction Gauge. Describes an ingenious device, invented by J. C. Jurgensen, for indicating in the basement of a building the direction and force of the winds outside. Ills. 1600 w. Met Work—March 21, 1908. No. 91072.

Calorimetry.

Radiation Correction for the Coal Calorimeter. Ernest H. Peabody. Explains methods of making the "radiation correction," giving a new formula. 1800 w. Stevens Ind—Jan., 1908. No. 91193 D.

Gages.

A Gage for Use in Producing Accurate Tapers. C. C. Stutz. Describes establishing the proportions of tapers by a gage with adjustable jaws set by a pair of disks. Gives formulae of service. 1000 w. Am Mach—Vol. 31, No. 13. No. 91164.

Testing Machines.

A Large Testing Machine for the Wisconsin Laboratory. H. F. Moore. Illustrated description. 2500 w. Wis Engr—Feb., 1908. No. 91226 D.

POWER AND TRANSMISSION.

Air Compressors.

The Efficiency of Dry Air Compressors (Beitrag zur Kenntnis des Wirkungsgrad trockener Luftkompressoren). W. Heilemann. A mathematical paper giving the results of very extensive tests. Ills. 4400 w. Zeitschr d Ver Deutscher Ing—Feb. 8, 1908. No. 90976 D.

Compressed Air.

Compressed Air in Modern Engineering. William Andrews. Describes a few of the large plants in the vicinity of New York City, using compressed air giving an idea of its extensive application. Discussion. 4500 w. Pro Brooklyn Engrs Club, No. 74—Vol. XI, 1907. No. 91238 N.

See also Compressed Air, and Hoisting Engines, under MINING AND METALLURGY, MINING.

Electric Driving.

Central-Stations and Electric-Motor Applications. Gives data and figures of motor applications in various industries compiled in the interest of the principal Edison companies. 3000 w. Elec Wld—March 7, 1908. No. 90731.

The Application of Motors to Machine Tools. Dexter S. Kimball. Considers points of importance in deciding whether to use the group or individual motor system; the motors and methods of constructing them; speed control, and matters relating to electric driving. 4500 w. Sib Jour of Engng—March, 1908. No. 91068 C.

The Sawmills of Messrs. J. & W. Bellhouse. Brief illustrated description of an installation of alternating-current machines at Manchester, England. 1000 w. Elec Rev, N Y—March 21, 1908. No. 91035.

Electric Power and Lighting in a Dynamite Plant. Warren Aikens. Describes a refrigerating system showing the advantage of using electricity. Ills. 1800 w. Elec Rev, N Y—March 28, 1908. No. 91190.

See also Shops, under MACHINE WORKS AND FOUNDRIES; and Insurance, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Lubricants.

Marine Engine Lubrication. A series of papers prepared by advocates of several kinds of lubricant, with the reprint of paper by H. C. Dinger. 6800 w. Int Marine Engng—April, 1908. No. 91109 C.

Lubrication.

See same title, under AUTOMOBILES; and Engine Lubrication, under STEAM ENGINEERING.

Power Plants.

Graphical Presentation of Power-Plant Costs. W. G. Way. Gives curves showing average capital and operating costs for several types of plants. 900 w. Power—March 17, 1908. No. 90878.

See also Plants, under MINING AND METALLURGY, MINING.

Shafting.

Alining Shafting by a Steel Wire. A. H. Nourse. Explains the method, giving table. 800 w. Am Mach—Vol. 31. No. 10. No. 90687.

STEAM ENGINEERING.

Boiler Efficiency.

See Flue-Gas Analysis, under STEAM ENGINEERING.

Boiler Fittings.

Blow-Off Valves for Steam Boilers. R. T. Strohm. Illustrates and describes types of these valves, and matters related. 2500 w. Elec Wld—March 7, 1908. No. 90732.

See also Engine Lubrication, under STEAM ENGINEERING.

Boiler Flues.

Advantages of Corrugated Flues. Vernon Smith. Aims to show their superiority. Ills. 1500 w. Prac Engr—Feb. 21, 1908. No. 90657 A.

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Boiler Furnaces.

See Smoke Prevention, under STEAM ENGINEERING.

Boiler Management.

Foaming and Priming in Boilers of Ice Plants. John C. Sparks. Discusses the causes, and their prevention. 2500 w. Ice & Refrig—March, 1908. No. 90715 C.

See also Plant Management, and Smoke Prevention, under STEAM ENGINEERING.

Boilers.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Boiler Settings.

Comparative Tests of Tabular Boiler Settings for Chicago Public Schools. Reports a series of tests to determine the relative evaporation and combustion efficiency of two types of boilers. Ills. 1200 w. Heat & Vent Mag—March, 1908. No. 91061.

Boiler Tests.

See Boiler Settings, under STEAM ENGINEERING.

Boiler Waters.

Boiler-feed Purification. H. Spurrier. Gives diagram and description of a feed-water purifying and softening plant. 1500 w. Power—March 3, 1908. No. 90632.

See also Economizers, and Feed-Water Heaters, under STEAM ENGINEERING.

Condenser Corrosion.

The Corrosion of Condenser Tubes. E. C. Sickles. Considers some factors involved in the selection of condenser equipment, especially for plants using salt circulating water. Ills. 4500 w. Power—March 10, 1908. No. 90746.

The Destruction of Condenser Tubes (Die Zerstörung von Kondensatorrohren). W. Heym. A discussion of materials and alloys for the construction of condensers. 1800 w. Serial. 1st part. Die Turbine—Feb. 20, 1908. No. 90960 D.

Condensers.

Air Pumps and Condensers. R. M. Ferguson. Read before the Manchester Assn. of Engrs. Deals with the effect upon the vacuum of certain features commonly met with in condensing systems. 4400 w. Mech Engr—Feb. 28, 1908. No. 90759 A.

See also Turbines, under STEAM ENGINEERING.

Economizers.

Economisers. W. W. Melville. Considers the advantages of heating feed water, the methods, etc. 4500 w. Pub Works—March, 1908. No. 90653 B.

Engine Design.

Gas and Steam-engine Proportions. W. H. Booth. A comparison. 1200 w. Power—March 3, 1908. No. 90631.

Engine Lubrication.

Worth-While Hints for Engineers and Steamfitters. William Kavanagh. Calls attention to details in boiler fittings and oiling systems. Ills. 1200 w. Power—March 10, 1908. No. 90752.

Engines.

A New Type of High Speed Engine. Illustrated description of a 160-h.p. angle-compound, with vertical-horizontal arrangement, recently put in operation at the plant of the American Engine Co. 1000 w. Engr, U S A—March 2, 1908. No. 90625 C.

Feed-Water Heaters.

Live Steam Feed-Water Heaters. Editorial criticism of paper by John Goodman and D. R. Maclachlan, before the Inst. of Mech. Engrs. 2800 w. Engr, Lond—Feb. 28, 1908. No. 90776 A.

Test of a Live-Steam Feed-Water Heater. John Goodman, and D. R. Maclachlan. Describes the plant and method of testing. The results lead to the conclusion that the heater has no material effect on the economy of the boiler. 2000 w. Inst of Mech Engrs—Feb. 21, 1908. No. 90758 N.

Flue-Gas Analysis.

Flue-gas Analysis and Boiler Efficiency. William D. Ennis. On the application of flue-gas analysis to the determination of the air supply and furnace losses and estimation of efficiency. 4000 w. Power—March 3, 1908. No. 90630.

Fuels.

Crude Oil as Fuel. William Chaddick Remarks on oil testing, its combustion, and points in installing this system. Ills. 1800 w. Engr, U S A—March 2, 1908. No. 90623 C.

Fuel Testing.

The Selection of Coal. From a paper by E. G. Bailey, recently read before the New England St. Ry. Club, giving conclusions from extensive experience in coal testing. 2500 w. Eng Rec—March 21, 1908. No. 91080.

See also Calorimetry, under MEASUREMENT.

Plant Management.

Sources of Economy in Power Production. W. H. Patchell. Especially with reference to colliery engineering. Describes uneconomical conditions often found, and changes needed. 12000 w. Ir & Coal Trds Rev—March 6, 1908. No. 90899 A.

Smoke Prevention.

How to Burn Bituminous Coal in Boiler Furnaces Without Smoke. L. P. Breckenridge. A discussion of the fundamental principles that apply to smokeless furnace construction and operation. General discussion follows. Ills. 12500 w. Pro St Louis Ry Club—Feb. 14, 1908. No. 90803.

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Steam Pipes.

Vibration in Steam Pipes. William F. Fischer. Briefly discusses the causes and prevention. Ills. 1100 w. Power—March 10, 1908. No. 90750.

Steam Piping for Industrial Plants. W. E. Housman. An illustrated discussion of the design and construction for moderate sized installations. 3000 w. Engineering Magazine—April, 1908. No. 91233 B.

Superheating.

The Specific Heat of Superheated Steam. Prof. Sidney A. Reeve. Gives results of the experiments by Peake and Thomas, with the author's conclusions as to methods to employ in future investigations. 3800 w. Power—March 10, 1908. No. 90749.

Turbine Auxiliaries.

Auxiliaries for Steam Turbines. Thomas Franklin. Explains their adaptation to the service, with especial reference to the points to be noted in their preparation for testing. 4000 w. Power—March 17, 1908. No. 90877.

Turbine Governing.

The Question of Steam Turbine Safety Governors. A discussion of the general conditions under which a turbine operates, and their bearing on safety governor design. 2200 w. Prac Engr—March 6, 1908. Serial. 1st part. No. 90884 A.

Hodgkinson's Turbine Governing Device. Illustrated description of a mechanically-actuated governing mechanism which operates in conjunction with the primary and secondary valves of a turbine. 2000 w. Mech Engr—March 13, 1908. No. 91131 A.

Turbines.

Exhaust Steam Turbines. Summarized translation of paper read by Prof. Auguste Rateau before the Soc. of Belgian Engrs. On the results of combining reciprocating engines and turbines. 2000 w. Engr, Lond—March 13, 1908. Serial. 1st part. No. 91146 A.

The Steam Path of the Turbine. Charles P. Steinmetz. A mathematical discussion of energy conversions, losses, etc. 3500 w. Pro Am Soc of Mech Engrs—March, 1908. No. 90801 C.

Steam Tables (Wasserdampftafel). Donat Bánki. Gives a diagram of temperature drop in adiabatic expansion for both saturated and superheated steam, with explanation of its use. Ills. 2800 w. Zeitschr f d Gesamte Turbinenwesen—Feb. 10, 1908. No. 90958 D.

The Principles of Steam-Turbine Buckets. William E. Snow. Gives a comparison of the different types of bucket, with a graphical explanation of their various forms and functions. 2500 w. Power—March 17, 1908. No. 90875.

The Belluzzo Two-Speed Steam Turbine. Illustrated description of a design aiming to be nearly as economical at half-speed as at full speed. 500 w. Engng—Feb. 28, 1908. No. 90771 A.

The Curtis Steam Turbine in Practice. Fred L. Johnson. How to determine if clearance between buckets and intermediates is right; the safety-stop, valve-gear, governor and stage valves. Ills. 1200 w. Power—March 10, 1908. No. 90748.

The Maschinenfabrik Augsburg-Nürnberg Steam Turbine (Die M. A.-N.-Dampfturbine). W. Koeniger. Illustrated detailed description of the Zoelly turbine built by this firm. 2800 w. Serial. 1st part. Zeitschr f d Gesamte. Turbinenwesen—Feb. 10, 1908. No. 90957 D.

The Kolb Elektra Steam Turbine and Rotary Condenser (Die Elektra-Dampfturbine und der Rotationskondensator von Kolb). H. Meuth. Illustrated description with details of efficiency tests, etc. 4300 w. Serial. 1st part. Zeitschr d Ver Deutscher Ing—Feb. 1, 1908. No. 90982 D.

Tests of an Eyermann Steam Turbine (Untersuchungen an der Eyermann-Dampfturbine). E. Josse. The first part of the serial describes the construction and operation of this type of turbine. Ills. 3200 w. Serial. 1st part. Zeitschr f d Gesamte Turbinenwesen—Feb. 20, 1908. No. 90959 D.

See also Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS; and Steam Turbines, under MARINE AND NAVAL ENGINEERING.

Turbine Testing.

Testing a Steam Turbine. Thomas Franklin. Considers special auxiliary plant for consumption test, test loads, and preparing the turbine for testing. 4000 w. Power—March 24, 1908. No. 91111.

Proper Method of Testing a Steam Turbine. Thomas Franklin. Special features to be examined before testing, importance of oiling system and water service, etc. Ills. 5000 w. Power—March 10, 1908. No. 90751.

TRANSPORTING AND CONVEYING.

Aerial Tramways.

Some German Overhead Tramways. Alfred Gradenwitz. Illustrates and describes new types in use in Germany, giving details of their operation. 3000 w. Eng & Min Jour—Feb. 29, 1908. No. 90612.

Cableways.

A South American Aerial Rope Railroad. An illustrated description of the construction of a line about 21 miles long, with a difference between levels of 11,600 feet. 2500 w. Sci Am Sup—March 28, 1908. No. 91178.

We supply copies of these articles. See page 322.

See also Aerial Tramways, and Material Handling, under TRANSPORTING AND CONVEYING.

Coal Handling.

See Dock Machinery, under TRANSPORTING AND CONVEYING.

Conveyors.

The Power Absorbed by a Bucket Elevator (Calcul de la Force Absorbée par une Chaine à Godets). A Hacardiaux. A mathematical discussion of a method of estimation. Ills. 1500 w. All Indus—Feb., 1908. No. 90917 D.

See also Dock Machinery and Material Handling, under TRANSPORTING AND CONVEYING.

Cranes.

Electrical Power in Railway Goods Warehouses. H. Henderson. Deals with the advantages to be gained, especially considering the crane and car hoist equipment of the new warehouse, at Newcastle-on-Tyne. Ills. 3000 w. Inst of Elec Engrs—Feb. 20, 1908. No. 90891 N.

See also Dock Machinery and Material Handling, under TRANSPORTING AND CONVEYING.

Dock Machinery.

Electric Power in Docks. C. E. Taylor. Describes uses to which electrical machinery has been put in connection with coal conveyors, cranes, capstans, etc. Ills. 3000 w. Inst of Elec Engrs—Feb., 1908. No. 90661 N.

Electric Power in Docks. C. E. Taylor. Read before the Inst. of Elec. Engrs. Illustrates and describes the principal uses to which electricity has been applied in docks, the driving of coal conveyors, cranes, capstans, etc. Discussion. 4000 w. Elec Engr, Lond—March 13, 1908. No. 91132 A.

Elevators.

The High-Pressure Hydraulic Elevator. William Baxter, Jr. Illustrates and describes the construction and operation of the Otis vertical machine. 1800 w. Power—March 24, 1908. No. 91112.

Hoists.

A Hoist for Feeding Material to the Concrete Mixer. Illustrates and describes an automatic feeding and delivering elevator for concrete. 1000 w. Eng News—March 5, 1908. No. 90695.

See also Cranes, under TRANSPORTING AND CONVEYING.

Material Handling.

Handling Heavy Armor-Plates for a Bank Vault. Illustrates and describes a difficult job of hoisting and handling in the construction of a bank vault in New York City. 700 w. Eng News—March 5, 1908. No. 90692.

Hoisting Machinery for the Handling of Materials. T. Kennard Thomson. Illustrated descriptions of cranes, cableways and transporting conveyors adapted to this work. 4500 w. Engineering Magazine—April, 1908. 2d part. No. 91231 B.

MISCELLANY.

Aeronautics.

How to Construct and Operate a One-Man Airship. Thomas S. Baldwin. Suggestions for the construction, operation and care. 2000 w. Sci Am —Feb. 29, 1908. No. 90600.

How to Construct a Balloon.—The Making, Inflating and Sailing of Gas Balloons. B. Courtright. An illustrated treatise explaining the elementary principles of aeronautics. 4500 w. Sci Am—March 28, 1908. No. 91177.

The First Successful Trial of a New American Aeroplane. Illustrated description of an aeroplane constructed by the Aerial Experiment Association, which was able to fly at the first attempt. 1200 w. Sci Am—March 21, 1908. No. 91022.

Textile Machinery.

Ring Spinning-Frames and Their Safety Appliances. Illustrated description of some of the protective appliances used on ring-spindles. 2000 w. Engng—Feb. 28, 1908. No. 90770 A.

MINING AND METALLURGY

COAL AND COKE.

Analysis.

See Fuel Testing, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Briquetting.

Lignite Briquetting in Germany. Robert Schorr. Explains the methods, describing apparatus used. 2500 w. Eng & Min Jour—Feb. 29, 1908. No. 90615.

Classification.

Classification of Coal. D. B. Dowling. Considers schemes of classification proposed, and suggests a scheme of names for Canadian coals. 1800 w. Qr Bul Can Min Inst—Feb., 1908. No. 91221 N.

Coke-Oven Gas.

See Blast-Furnace Gas, under IRON AND STEEL.

Coke Ovens.

The Von Bauer Coke-Oven System. Illustrated description of the by-product coke-oven system devised by one of the most experienced coke-oven engineers in

Germany. 2800 w. Elec-Chem & Met Ind—March, 1908. No. 90645 C.

The By-Product Coke Oven. William Hutton Blauvelt. An illustrated discussion of the types of by-product oven used in the United States, and the problems in connection. 7500 w. Pro Am Soc of Mech Engrs—March, 1908. No. 90800 C.

Modern Coke Ovens (Les Fours à Coke Modernes). F. Fieschi. A general review and a description of a new oven for operation either with or without recovery of by-products. Ills. 3500 w. Serial. 1st part. Génie Civil—Feb. 22, 1908. No. 90924 D.

Coking Plants.

The Phillips Plant of the H. C. Frick Coke Co. Plan and illustrated description of a coke plant embodying the latest practice. 2000 w. Mines & Min—March, 1908. No. 90680 C.

Notes on Canadian Retort Coke and Its Manufacture. Randolph Bolling. Illustrated detailed description of the coke plant, on Cape Breton Island. It consists of 120 Bernard ovens, grouped in three batteries of 40 ovens each, and 30 Bauer ovens. 3500 w. Eng News—March 5, 1908. No. 90691.

Placing the By-Product Coking Plant in Operation (Die Inbetriebsetzung von Teerkokereien). A. Thau. A practical discussion of the method of starting coke ovens. Ills. 3500 w. Glückauf—Feb. 22, 1908. No. 90943 D.

Colorado.

The Coals and Coal Fields of Colorado. Arthur Lakes. Map and description of deposits which include all varieties of coal. 1700 w. Min Wld—March 28, 1908. No. 91253.

Electric Power.

The Development of the Flameproof Motor. Illustrates and describes a type of motor-casing, on the lines of the Davis safety lamp. 1200 w. Elect'n, Lond—March 13, 1908. No. 91136 A.

Some Applications of Electric Power in Belgium (Quelques Applications de l'Electrotechnie en Belgique). Alfred Lambotte. The first part of the serial discusses electric power in mining with particular reference to the equipment and operation of the Elisabeth collieries at Auvelais. Ills. 8000 w. Serial. 1st part. Soc Belge des Elec'ns—Feb., 1908. No. 90901 E.

Explosions.

Darr Mine Disaster. An illustrated account of the disaster near Pittsburg, with the opinions of inspectors and experts, and editorial. 7500 w. Mines & Min—March, 1908. No. 90678 C.

Recent Explosions in Coal Mines. H. M. Chance. Reviews the conditions under which the coal-mining industry in the United States has been developed, showing that safety measures have not kept pace with increasing dangers. 3000 w. Eng & Min Jour—March 14, 1908. No. 90850.

Mexico.

Coal in Coahuila. Ezequiel Ordoñez. Discusses the coal industry in Mexico, and describes the Coahuila coalfields. 1500 w. Min & Sci Pr—March 14, 1908. No. 91032.

Mine Records.

See Filing Systems, under INDUSTRIAL ECONOMY.

Mining.

Plans for Mining a Flat Coal Seam. Audley H. Stow. Considers details of economical development. Ills. 3000 w. Eng & Min Jour—March 7, 1908. No. 90737.

See also Eight-Hour Day, under INDUSTRIAL ECONOMY.

Mining Plants.

See Plant Management, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

New Brunswick.

The Carbonaceous and Bituminous Minerals of New Brunswick. R. W. Ells. Describes the deposits and their development. 3800 w. Qr Bul Can Min Inst—Feb., 1908. No. 91220 N.

Oklahoma.

The Rock Island Coal Co.'s Mines, Oklahoma. R. S. Moss. An illustrated account of the mines operated by this company. 1100 w. Min Wld—March 7, 1908. No. 90742.

Pennsylvania.

The Sagamore Bituminous Coal Mines. Edward K. Judd. Illustrated description of these mines in the Clearfield district of Pennsylvania. 1200 w. Eng & Min Jour—March 21, 1908. No. 91089.

The Southern Anthracite Coalfield. John Haertter. An illustrated account of important development work in the Pottsville coalfields, with review of its early history. 2000 w. Eng & Min Jour—March 28, 1908. No. 91209.

Rescue Appliances.

Rescue Appliances in the Mines of France. Jacques Boyer. An illustrated article devoted principally to descriptions of respiratory appliances. 5800 w. Engineering Magazine—April, 1908. No 91228 B.

Modern Life Saving Apparatus for Mines. Frank C. Perkins. The Draeger apparatus is illustrated and described and information relating to its efficiency is given. 2500 w. Min Wld—Feb. 29, 1908. No. 90619.

Sampling.

See Weathering, under COAL AND COKE.

We supply copies of these articles. See page 322.

Storage.

The Storage of Anthracite Coal. Explains the conditions that have made necessary the construction of storage plants for both anthracite and bituminous coal, and describes the main features of some of the plants. 2500 w. Eng Rec—March 28, 1908. No. 91205.

Washing.

The Bituminous Washery at Tyler, Penn. Edward K. Judd. Illustrated description of a plant run by independent motors. The sulphur and ash contents are reduced about one-half. 1200 w. Eng & Min Jour—Feb. 29, 1908. No. 90614.

See also Magnetic Separation, under ORE DRESSING AND CONCENTRATION.

Weathering.

The Weathering of Coal. S. W. Parr and N. D. Hamilton. Gives a résumé of the statements by various writers, showing the present knowledge available, and an outline of experimental work. Also a report on the deterioration of samples in storage, by S. W. Parr and W. F. Wheeler. 8500 w. Univ of Ill, Bul. No. 17—Aug., 1907. No. 90874 N.

Yukon.

Yukon Territory, Between White-Horse and Tantalus. Official report of D. D. Cairnes, describing the topography and flora, the geology, coal and copper properties examined, etc. Ills. 3500 w. B C Min Rec—Feb., 1908. No. 91118 B.

COPPER.

Assaying.

Notes on the Practice of Assaying in British Columbia. C. S. Baker. Gives a few of the methods of treating the silver-lead-zinc and the copper-gold-silver ores. 2000 w. Qr Bul Can Min Inst—Feb., 1908. No. 91217 N.

British Columbia.

The Bulkley Valley District, in Skeena Mining Division. Information from the official report by W. W. Leach. Ills. 2500 w. B C Min Rec—Feb., 1908. No. 91117 B.

The Geology and Ore Deposits of Franklin Camp, B. C. R. W. Brock. Describes the somewhat complicated geology and deposits of various types. Ills. 3300 w. Jour Can Min Inst—Vol. X, 1907. No. 91152 N.

Mineral Locations on Moresby Island, Queen Charlotte Group. Report by William Fleet Robinson, reviewing the history of early voyages of discovery to these islands, geological observations made, prospecting, etc. 9000 w. B C Min Rec—Feb., 1908. No. 91119 B.

California.

Foothill Copper Belt of the Sierra Nevada. John A. Reid. Presents facts necessary to a proper understanding and development of the copper belt, and which may be readily used by the miner or prospector. Ills. 4000 w. Min & Sci Pr—March 21, 1908. No. 91182.

Chile.

The Poderosa Copper Mines, Collahuasi, Chile. Robert Hawxhurst, Jr. Describes this mine in the Andes, the geology, deposits, labor conditions, etc. 1800 w. Eng & Min Jour—March 7, 1908. No. 90734.

Colorado.

See same title, under GOLD AND SILVER.

Converters.

Apparatus for Converting Mattes and Speisses. Herbert Haas. Illustrated description of the writer's invention, which is an improved process for converting copper and other mattes, also speisses and other metallic compounds. 1600 w. Min Wld—March 21, 1908. No. 91093.

East Indies.

Gold and Copper Mining in the Dutch East Indies. Information in regard to results during 1907. 1300 w. Min Jour—Feb. 29, 1908. No. 90767 A.

Lake Superior.

Underground Mining Methods at the Quincy Copper Mine, Michigan. G. R. McLaren. Student's prize paper. Briefly considers the geology, the deposits and their origin, and the mining methods. Ills. 4000 w. Jour Can Min Inst—Vol. X 1907. No. 91157 N.

Refining.

The Electrolytic Copper-Refining Industry. John B. C. Kershaw. Considers the growth of this industry, recent changes, and gives brief descriptions of American and English plants. 3000 w. Elec Rev N Y—March 28, 1908. No. 91189.

Reverberatory Furnaces.

Coal-Dust Firing for Reverberatory Furnaces. Charles F. Shelby. Gives results of observations made at Cananea. The powdered ash introduces complications, and possibly waste heat boilers would not be of value. 4000 w. Eng & Min Jour—March 14, 1908. No. 90847.

Roasting.

The Dwight and Lloyd Sintering Process. Arthur S. Dwight. Illustrated description of a new blast-roasting process in which the material is sintered continuously in thin layers. 3000 w. Eng & Min Jour—March 28, 1908. No. 91208.

Smelting.

Matte Smelting at Ingot, California. W. B. Bretherton. An illustrated description of the smelting operations. 1500 w. Eng & Min Jour—Feb. 29, 1908. No. 90611.

Copper Smelting at Mammoth Plant. A. S. Haskell. Illustrated description of the enlarged plant of the U. S. Smelting, Refining and Mining Co., at Kennett, Cal.

2000 w. Mines & Min—March, 1908. No. 90681 C.

See also Converters, and Reverberatory Furnaces, under COPPER; and Refractory Materials, under MISCELLANY.

Tasmania.

The Mt. Lyell Copper Field, Tasmania. Ralph Stokes. Describes this district, its climate, geology, deposits, and the mining properties. Ills. 2500 w. Min Wld—March 21, 1908. Serial. 1st part. No. 91094.

Yukon.

See same title, under COAL AND COKE.

GOLD AND SILVER.

Assaying.

See same title, under COPPER.

British Columbia.

Camp Hedley, Similkameen District. Charles Camsell. An official report describing the topographic features, the general geology, etc. Ills. 4500 w. B C Min Rec—Jan., 1908. No. 90854 B.

Observations on the Geology and Ore Deposits of Camp Hedley, British Columbia. Charles Camsell. Describes the deposits of auriferous arsenopyrite and discusses their origin. 3500 w. Qr Bul Can Min Inst—Feb., 1908. No. 91219 N.

See also Hydraulic Mining, under GOLD AND SILVER.

Cerargyrite.

See Ore Deposits, under MISCELLANY.

Cobalt.

A Visit to the Cobalt District in Ontario. Alex. Gray. Gives results being obtained at some of the mines, and reformations in progress. Ills. 900 w. Min Wld—March 7, 1908. No. 90741.

A Review of Cobalt Results to Date. Alex. Gray. Discusses the methods of the Cobalt camp, its development and ore output. 1800 w. Min Wld—Feb. 29, 1908. No. 90621.

Mining at Cobalt. Frank C. Loring Considers the Cobalt silver mining district from the standpoint of the miner and mine operator. 1700 w. Qr Bul Can Min Inst—Feb., 1908. No. 91222 N.

The Cobalt Mining District. Dr. Robert Bell. Deals with points in connection with the geology of the Cobalt district and the nature of the metalliferous deposits. 3500 w. Jour Can Min Inst—Vol. X, 1907. No. 91149 N.

See also Sampling, under ORE DRESSING AND CONCENTRATION.

Colorado.

Re-birth of a Colorado Mine. Thomas Tonge. An account of the gold-copper Donaldson mine, and the favorable conditions due to the construction of the Rockford tunnel. 2200 w. Min Jour—March 7, 1908. No. 90898 A.

The General Geology of Summit County, Colorado. A. Lakes. Special reference to Breckenridge and vicinity, the topography of the region, the ore deposits, the origin of gold in the placers, etc. Ills. 1000 w. Min Sci—March 5, 1908. Serial. 1st part. No. 90739.

Cyaniding.

Hendryx Cyaniding. L. D. Bishop. Deals with the physical or mechanical treatment of ore, rather than the chemical, with special reference to the Hendryx methods of agitation and filtration. 2500 w. Aust Min Stand—Feb. 5, and 12, 1908. Serial. 2 parts. No. 91025 each B.

Notes on Preliminary Cyanidation Work. H. F. A. Riebling. On the tests advisable to determine whether or not a mine can be made to pay a profit by installing the cyanide process of ore treatment. 2000 w. Min Wld—March 7, 1908. No. 90743.

See also Silver Milling, under ORE DRESSING AND CONCENTRATION.

East Indies.

See same title, under COPPER.

Honduras.

Properties of the New York & Honduras Rosario Mining Co. Francis C. Nicholas. Gives the history of these mines, which yield gold, silver and other metals of value. Ills. 2000 w. Min Wld—Feb. 29, 1908. No. 90620.

Hydraulic Mining.

The Cariboo Consolidated Hydraulic Plant, Bullion, B. C. W. J. Dick. Student's prize paper. Describes this property and its development. 2500 w. Jour Can Min Inst—Vol. X, 1907. No. 91158 N.

Mexico.

See Silver Milling, under ORE DRESSING AND CONCENTRATION.

Nevada.

The Gold Camp of Rawhide, Esmeralda, Co., Nevada. Dr. Charles A. Gehrmann. An account of the discovery and progress of a new camp in the desert, the deposits found, etc. 1600 w. Min Sci—March 16, 1908. No. 91116.

See also Gold Milling, under ORE DRESSING AND CONCENTRATION.

Nova Scotia.

The Oldham Sterling Gold Mine, Nova Scotia. C. V. Brennan. Student's prize paper. Describes the mine and methods of working. Ills. 3500 w. Jour Can Min Inst—Vol. X, 1907. No. 91159 N.

Placers.

See Colorado, and Hydraulic Mining, under GOLD AND SILVER.

Rand.

The Origin of the Gold in Banket. J. S. Curtis. Combats views advanced in paper by Prof. J. W. Gregory. 3500 w.

We supply copies of these articles. See page 322.

Jour Chem, Met, & Min Soc of S Africa —Jan., 1908. No. 90880 E.

Refining.

Proof Gold and Silver. John W. Pack. Detailed description of the method used in the preparation. 900 w. Min & Sci Pr—March 7, 1908. No. 90810.

Utah.

See same title, under LEAD AND ZINC.

IRON AND STEEL.

Alabama.

Brown Ore Mining in the Russellville District, Alabama. F. Wm. Hausmann. Describes the ore and the plants and methods of mining. Ills. 1200 w. Stevens Ind—Jan., 1908. No. 91196 D.

Assaying.

A Canadian Method for the Technical Determination of Silicon in Pig Iron. Randolph Bolling. An explanation of the method used in the Nova Scotia Steel & Coal Company's laboratory. Ills. 1500 w. Can Min Jour—March 15, 1908. No. 91026.

The Determination of Phosphorus in Steel (Ueber die Phosphorbestimmung im Stahl). M. Frank and F. Willy Hinrichsen. Results of investigations at the Imperial Testing Laboratory. 2500 w. Stahl u Eisen—Feb. 26, 1908. No. 90936 D.

The Determination of Sulphur in Iron and Steel (Schwefelbestimmung in Eisen und Stahl). H. Kinder. The results of researches by the Commission on Chemistry of the German Ironmaker's Association. Ills. 3500 w. Stahl u Eisen—Feb. 19, 1908. No. 90934 D.

See also Blast Furnace Practice, under IRON AND STEEL.

Australia.

Iron Making in Australia. A. Selwyn-Brown. Brief account of the industry, the financial difficulties, etc. 1200 w. Eng & Min Jour—March 21, 1908. No. 91088.

Blast-Furnace Fuels.

Charcoal:—The Blast Furnace Fuel for Ontario. R. H. Sweetzer. Presents the advantages of this fuel. Ills. 1500 w. Qr Bul Can Min Inst—Feb., 1908. No. 91223 N.

Blast-Furnace Gas.

Furnace-Gas Diagrams. Reproduces the circular diagram of M. Leon Greiner, and gives another form of diagram prepared by him showing the same quantities, but disposed in a more effective manner. 1700 w. Cassier's Mag—March, 1908. No. 90827 B.

The Utilization of Blast-Furnace and Coke-Oven Gases in Metallurgical Works (Utilisation du Gaz des Hauts-Fourneaux et des Fours à Coke dans les Usines Metallurgiques). Léon Greiner. A general discussion and a description of the results obtained by the Cockerill Company at Seraing. Ills. 900 w. All Indus—Feb., 1908. No. 90916 D.

Blast-Furnace Practice.

Making Basic Iron with High Sulphur Coke. Randolph Bolling. A report of the experience of the Dominion Iron & Steel Co. 1500 w. Ir Age—March 5, 1908. No. 90682.

Preparation of Materials for the Blast Furnace. David Baker. Describes the nodulizing process which reduces the sulphur and prepares the ore for smelting. 2500 w. Eng & Min Jour—March 21, 1908. No. 91090.

The Uses of Chemical Analysis in Iron Blast Furnace Practice and Some Notes on Laboratory Methods. George D. Drummond. Student's prize paper. Treats chiefly of the methods at the Midland Blast Furnace, Ontario. Describes the plant which smelts Lake Superior ores with Connellsville coke. 7000 w. Jour Can Min Inst—Vol. X, 1907. No. 91160 N.

Blast Furnaces.

See Refractory Materials, under MISCELLANY.

Blast-Furnace Slag.

See Cement, under MINOR MINERALS.

Electro-Metallurgy.

Steel Making by Electricity. An illustrated review of modern processes. Sci Am Sup—Feb. 22, 1908. No. 90586.

The Electrical Smelting of Pig Iron. Horace Allen. Gives figures showing to some extent the variation in the current expended by the different systems and on different qualities of ore, and related information. 700 w. Mech Engr—Feb. 28, 1908. No. 90760 A.

The Electrothermic Production of Steel from Iron Ore. Alfred Stansfield. A brief account of experiments made to determine whether, in smelting iron ores for the direct production of steel, phosphorus and sulphur would be eliminated. 1500 w. Jour Can Min Inst—Vol. X, 1907. No. 91151 N.

The Induction Furnace and Its Use in the Steel Industry. Abstract translation of a recent paper by Viktor Engehardt in *Elektrotechnische Zeitschrift* discussing the application of the electric induction furnace in the steel industry. Ills. 1200 w. Elec-Chem & Met Ind—April, 1907. No. 91247 C.

Germany.

The Ahaus and Koesfeld Clay Ironstone Deposits and Their Economic Value (Das Toneisensteinvorkommen von Ahaus und Koesfeld und seine wirtschaftliche Bedeutung). Herr Willert. A description of the deposits and the ores and a discussion of their utilization. 3200 w. Glückauf—Feb. 29, 1908. No. 90944 D.

We supply copies of these articles. See page 322.

Metallography.

The Separation of Graphite in the Smelting of Iron-Carbon Alloys of High Carbon Content (Zur Kenntnis der Graphitausscheidung in Eisenkohlenstoffschmelzen hohen Kohlenstoffgehalts). W. Gahl. A review of various theories. Ills. 2100 w. Stahl u Eisen—Feb. 12, 1908. No. 90933 D.

New York.

On the Associations and Origin of the Non-titaniferous Magnetites in the Adirondack Region. David Hale Newland. Describes the geology of the region, the ore deposits and their occurrence, discussing their origin. 3500 w. Ec Geol—Dec., 1907. No. 91043 D.

Ontario.

The Iron Ores of Ontario. A. B. Willmott. A statement of opportunities open for the iron-ore miner, describing the character of the ores. Map. 5500 w. Can. Min Jour—March 15, 1908. No. 91030.

The Moose Mountain Iron Range, with Special Reference to the Properties of Moose Mountain, Limited. Norman L. Leach. A report of the development work and deposits of this Canadian property. 800 w. Can Min Jour—March 15, 1908. No. 91029.

Open-Hearth.

Basic Open-Hearth Steel Manufacture, as Carried Out by the Dominion Iron and Steel Company at Sydney, C. B. Frank E. Lathe. Student's prize paper. Detailed description. Ills. 7000 w. Jour Can Min Inst—Vol. X, 1907. No. 91156 N.

Pyrites.

See Ore Deposits, under MISCELLANY.

Roasting.

The Wilfley Furnace. J. M. McClave. Illustrates and describes a furnace of the tower type for roasting iron sulphides in preparation for magnetic separation. 800 w. Eng & Min Jour—Feb. 29, 1908. No. 90613.

Steel Making.

The Thomas Process (Etude sur le Procédé Thomas). J. Dangel. A description of the theory and practice of the process, the influence of impurities, conduct of the operation, etc. 4000 w. Bul Sci de l'Assn des Elèves—Jan., 1908. Serial. 1st part. No. 90900 D.

Steel Works.

The Manufacture of Concrete Reinforcing. Illustrates and describes the process of making Kahn bars by the Trussed Concrete Steel Co. 1500 w. Ir Trd Rev—March 12, 1908. No. 90808.

See also Open Hearth, under IRON AND STEEL; Steel Buildings, under CIVIL ENGINEERING, CONSTRUCTION; and Shops, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Trade.

See Royalties, under MINING.

U. S. Steel Corporation.

The United States Steel Corporation's Annual Report. Abstracts and general review of the sixth annual report. 6000 w. Ir Age—March 26, 1908. No. 91161.

LEAD AND ZINC.

Assaying.

See same title, under COPPER.

Great Britain.

Lead-Mining in Great Britain. Editorial review of the various lead-mining districts, discussing their possibilities. 1800 w. Engng—March 6, 1908. No. 91003 A.

Joplin District.

Zinc and Lead Deposits of South Western Missouri. F. Lynwood Garrison. Describes the deposits of the Joplin district, discussing their origin and comparing theories of a number of geologists. Ills. 2000 w. Min & Sci Pr—Feb. 29, 1908. Serial. 1st part. No. 90708.

Lead.

Lead: Its History and Economic Development. Evans W. Buskett. A review of its development in the United States, describing its properties, occurrence, mineralogy, etc. 1200 w. Min Wld—March 14, 1908. Serial. 1st part. No. 90853.

Roasting.

See same title, under COPPER.

Utah.

Mining and Milling at Stockton, Utah. Robert B. Brinsmade. Describes the methods used at the Honerine silver-lead mine and mill. Ills. 2000 w. Eng & Min Jour—March 21, 1908. No. 91091.

Daly-West Mine and Mill. Robert B. Brinsmade. Describes this silver-lead mine and its development, methods of working, surface equipment, etc. Ills. 5000 w. Mines & Min—March, 1908. No. 90675 C.

Zinc.

Notes on Zinc. The present article considers its physical and chemical properties, compounds, impurities, ores and localities, and production. 3500 w. Mech Engr—March 6, 1908. Serial. 1st part. No. 90886 A.

Zinc Industry.

A Review of the Zinc Industry. H. M. Burkey. Reviews the present state of the industry. 3000 w. Elec-Chem & Met Ind—March, 1908. No. 90643 C.

Zinc Smelting.

Recent Advances in the Metallurgy of Zinc. Woolsey McA. Johnson. A review of progress in the treatment of zinc ores, both in the concentration methods, and in the spelter plant. 4000 w. Jour Fr Inst—March, 1908. No. 91066 D.

See also Converters, under COPPER.

MINOR MINERALS.

Aluminium.

On the Direct Reduction of Alumina by Carbon. R. S. Hutton and J. E. Petavel. Part of a paper read before the Royal Soc. of London. Discusses the possibilities of direct reduction. 2500 w. Elec-Chem & Met Ind—March, 1908. No. 90644 C.

Antimony.

Antimony Mining in Peru and Bolivia. G. Preumont. An examination of the possibilities of antimony mining in these two countries. 1800 w. Min Jour—March 7, 1908. No. 90896 A.

Cement.

A New Rotary Kiln Cement Plant. Illustrated description of a new rotary kiln plant at Greenhithe, and of the process of manufacture. 4500 w. Engr, Lond—Feb. 28, 1908. No. 90775 A.

The New Mill of the California Portland Cement Company. Illustrated description of a new cement mill, with a capacity of 2500 barrels a day, recently placed in operation at Colton, Cal. 3500 w. Eng Rec—March 7, 1908. No. 90705.

Portland Cement and Slag Cement (Portlandzement und Eisen-Portlandzement). H. Wedding. A comparison, and a discussion of the production of slag cement as a steel-works by-product. 4500 w. Stahl u Eisen—Feb. 12, 1908. No. 90932 D.

Diamonds.

The Kimberlite Rock and the Origin of Diamonds. F. W. Voit. Gives a description of the rocks and the eluvial diamond deposits, the eclogite nodules, etc. 4000 w. Min Jour—Feb. 22, 1908. No. 90662 A

Graphite.

Modes of Occurrence of Canadian Graphite. H. P. H. Brunnell. Considers only the ore found in the Archaen rocks, from which the crystalline or flake variety is obtained. 2000 w. Can Min Jour—March 15, 1908. No. 91027.

See also Graphite Crucibles, under MISCELLANY.

Lime.

The Schmatolla System of Gas-Fired Lime-Kilns. Illustrates and describes a form of gas-fired kiln which seems satisfactory. 900 w. Engng—Feb. 28, 1908. No. 90772 A.

Calculating the Heat Balance of Lime Kilns. Robert Schorr. Gives facts relating to the combustion of coal, wood, oil, and producer-gas in calculating the efficiency of direct and gas-fired lime kilns. 2500 w. Eng & Min Jour—March 21, 1908. No. 91092.

Manganese.

On the Original Type of the Manganese Ore Deposits of the Queluz District, Minas Geraes, Brazil. Orville A. Derby. Some information of importance in determining the genesis of this type of manganese ore deposits. 1200 w. Am Jour of Sci—March, 1908. No. 90802 D.

Nickel.

Recovery of Nickel from Oxide and Silicate Ores. Wm. Koehler. Describes a process for handling ores which are not readily amenable to smelting methods. 1800 w. Elec-Chem & Met Ind—April, 1908. No. 91248 C.

Potash.

Potash Mining in Germany (Deutschlands Kalibergbau). A general review. 3500 w. Oest Zeitschr f Berg- u Hüttenwesen—Feb 29, 1908. No. 90939 D.

Salt.

The Saline Deposits of Carmen Islands. Edward H. Cook. Illustrates and describes these deposits in the Gulf of California. 800 w. Eng & Min Jour—March 14, 1908. No. 90848.

Sulphur.

A Historic Sulphur Mine in Durango, Mexico. Douglas Muir. Describes the deposits and methods of mining and refining. 700 w. Min Sci—Feb. 27, 1908. No. 90592.

Sulphuric Acid.

The Suitability of Sicilian Sulphur Ore for the Manufacture of Sulphuric Acid. Guiseppe Oddo. Gives results of experiments, and a statement of important advantages resulting from the treatment of sulphur ores. 1500 w. Min Jour—March 14, 1908. No. 91138 A.

Tin.

Tin Mining in Tasmania. James B. Lewis. Describes the extent and nature of the tin-bearing deposits and the condition of the mines. Ills. 3000 w. Eng & Min Jour—March 7, 1908. No. 90733.

MINING.

Borehole Surveying.

A New Borehole Surveying Instrument (Ein neuer Lotapparat für Bohrlöcher). Karl Haussmann. Illustrated description of the author's photographic device. 2800 w. Glückauf—Feb. 15, 1908. No. 90942 D.

Compressed Air.

Simple Problems in Air-Compression. Edward A. Rix. An address before the Min. Assn. of the Univ. of California. An explanation of the principles involved in the use of compressed air for various purposes in mining. 3500 w. Min & Sci Pr—March 21, 1908. No. 91183.

Diamond Drilling.

Notes on Cost of Diamond Drilling in the Boundary District. Frederick Keffer. Gives tabulated results of this work, with explanatory notes. 1000 w. Can Min Jour—March 15, 1908. No. 91028.

We supply copies of these articles. See page 322.

Drainage.

Drainage in Cripple Creek, Colorado, Gold Camp. T. R. Countryman. Considers the sources of the water, and gives the history of the Cripple Creek drainage tunnel. 1500 w. Min Sci—March 19, 1908. Serial. 1st part. No. 91115.

Drilling.

See Shaft Sinking, under MINING.

Drills.

Notes on Small Stope Drills. Discussion of paper by E. M. Weston. 800 w. Jour Chem, Met, & Min Soc of S Africa —Jan, 1908. Serial. 1st part. No. 90882 E.

The South African Stope-Drill Competition. Eustace M. Weston. The results proved the superiority of air-hammer drills as a one-man drill. Ills. 2200 w. Eng & Min Jour—March 7, 1908. No. 90735.

Electric Hoisting.

Losses in Ilgner Hoisting Plants and the Determination of the Most Economical Slip for Their Starting Motors (Verluste bei Ilgner-Förderanlagen und Bestimmung der wirtschaftlichsten Schlüpfung iher Anlassmotoren). L. Becker. A mathematical discussion illustrated with curves. 1800 w. Glükauf—Feb. 8, 1908. No. 90941 D.

Electric Power.

Electric Power Installation at Belgian Mines. F. C. Perkins. Special reference to Peronnes and St. Albert plants supplying power to large coal mines. Ills. 1500 w. Min Sci—Feb. 27, 1908. No. 90591.

The Central Power Plant of the Berwind-White Coal Mining Company at No. 40 Mine, Windber, Pa. William L. Affelder. Illustrates and describes a plant that will furnish power for six large mines. 1500 w. Mines & Min—March, 1908. No. 90677 C.

Engineering Ethics.

The Status of the Mining Profession. J. C. Gwillim. Describes the gambling element in mining and steps to correct the evil. Discussion. 7000 w. Jour Can Min Inst—Vol. X, 1907. No. 91154 N.

Explosives.

Method of Thawing Explosives. Abstract of a paper by P. N. Dennison, read before the Ohio State Stone Club. Discusses the dangers, describing safe methods of thawing and handling. 2000 w. Engng-Con—March 11, 1908. No. 90807.

Finance.

Value of Mining Stock. M. L. Requa. An argument for the making of San Francisco a financial center for the mining industry. 2000 w. Min & Sci Pr—March 7, 1908. No. 90811.

Hoisting.

Accidents in Winding, with Special Reference to Ropes, Safety Cages, and Controlling Devices for Colliery Winding Engines. G. H. Winstanley. Abstract of lecture before the Manchester Geol. & Min. Soc. 5500 w. Col Guard—March 13, 1908. No. 91139 A.

Hoisting Engines.

Dense-Air Winding-Engine for the Consolidated Gold-Fields of South Africa. Explains this system, and illustrates and describes an engine designed by H. C. Behr, for its application. 3000 w. Engng —March 13, 1908. No. 91142 A.

Locomotives.

Mine Locomotives, with Special Reference to Benzine Locomotives (Die Grubenlokomotiven mit besonderer Berücksichtigung der Benzinlokomotive). A. Kás. The operation and efficiency of compressed air, electric and benzine locomotives. 2000 w. Serial, 1st part. Oest Zeitschr f Berg- u Hüttenwesen—Feb. 8, 1908. No. 90937 D.

Plants.

The Installation of the Steam Power Mine Plant. Otto Ruhl. Notes relating to the boiler house, setting of and foundations for boiler, etc. 1700 w. Min Sci —March 5, 1908. No. 90740.

Pumping.

New Unwatering Plants with Sulzer High-Pressure Centrifugal Pumps in the Ruhr Coal District (Neuere Wasserhaltungen mit Sulzer-Hochdruck-Zentrifugalpumpen im Ruhrkohlenrevier). A. Thimm. Illustrated description of several plants. 2000 w. Glückauf—Feb. 8, 1908. No. 90940 D.

Royalties.

The Mining Royalty Burden on British Iron and Steel. T. Good. Discusses this tax in Great Britain, considering it highly burdensome on production. 1700 w. Cassier's Mag—March, 1908. No. 90825 B.

Shafts.

See Timbering, under MINING.

Shaft Sinking.

Improvements in Crossheads for Shaft Sinking. Eustace M. Weston. Illustrates and describes devices for preventing accidents. 1000 w. Eng & Min Jour—March 7, 1908. No. 90736.

Machine vs. Hand Drilling in Sinking on the Rand. Eustace M. Weston. Hand sinking is at present more popular, but future development and labor shortage will probably cause machine-sinking to become preferable. Ills. 3500 w. Eng & Min Jour—Feb. 29, 1908. No. 90610.

Stoping.

See Drills, under MINING.

Timbering.

Shaft Timbering, Brakpan, Transvaal, S. A. Eustace M. Weston. Describes the method of framing. 1000 w. Eng & Min Jour—March 14, 1908. No. 90849.

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Unwatering.

Tapping Mine Water Under Great Pressure. Robert Sibley. Reviews the history of the Iron Mountain Tunnel Co. and this silver-lead mine at Superior, Mont., and describes the proposed method of tapping the water. Ills. 2000 w. Eng & Min Jour—March 14, 1908. No. 90851.

ORE DRESSING AND CONCENTRATION.

Crushing.

Crushing Ore. M. P. Boss. Aims to make clear the fundamental principles of ore crushing. 4000 w. Min & Sci Pr—March 14, 1908. No. 91031.

Drying.

Drying Appliances. Oskar Nagel. Illustrates and describes methods of artificial drying and apparatus used. 2000 w. Elec-Chem & Met Ind—April, 1908. No. 91249 C.

Gold Milling.

The Montgomery-Shoshone Mill of the Bullfrog Reduction and Water Co., Rhyolite, Nevada. P. E. Van Saun. Illustrated description of the equipment and methods of milling. 2500 w. Mines & Min—March, 1908. No. 90679 C.

Experimental Studies on the Work of Water Jigs. Abstract translation of a paper by Gust. G. Bring, *Jernkontorets Annaler*. Considers the fall in narrow channels, influence of currents, behavior under suction, etc. 2000 w. Eng & Min Jour—March 28, 1908. No. 91207.

Lead Milling.

See Utah, under LEAD AND ZINC.

Magnetic Separation.

The Possibility of Reducing the Ash-Content of Coal by Electro-Magnetic Means. E. Prost, *Bul. Soc. Chimique de Belgique*. A report of experiments showing the percentage of ash may be lowered, but the method is too costly to supersede washing. 1000 w. Col Guard—Feb. 21, 1908. No. 90663 A.

See also Roasting, under IRON AND STEEL.

Ore Dressing.

The Present Status of the Art of Ore Dressing. W. G. Swart. Presidential address discussing the general problems of concentration and separation in hydraulic, pneumatic, magnetic and static fields. 1700 w. Min Sci—March 26, 1908. Serial, 1st part. No. 91251.

Sampling.

The Sampling of Silver-Cobalt Ores at Copper Cliff, Ontario. Arthur A. Cole. Describes the methods used. Ills. 1200 w. Qr Bul Can Min Inst—Feb., 1908. No. 91218 N.

Silver Milling.

Some Features of Silver Ore Treatment in Mexico. W. A. Caldecott. Notes on works practice and present day cyanide treatment. 2500 w. Jour Chem, Met & Min Soc of S Africa—Jan., 1908. No. 90881 E.

A Small Lixiviation Plant in Mexico. H. A. Horsfall. Illustrates and describes the reconstruction of the old Ocampo silver mill in Chihuahua, the ores treated, the manner of operating, giving tabulated statements of ore worked and the cost. 2500 w. Min Wld—March 28, 1908. No. 91252.

Zinc Milling.

See Zinc Smelting, under LEAD AND ZINC.

MISCELLANY.

British Columbia.

Review of Progress in the Mineral Production of British Columbia. E. Jacobs. 1500 w. Jour Can Min Inst—Vol. X, 1907. No. 91153 N.

Canada.

The Mineral Production of Canada in 1907. John McLeish. A preliminary report. 2500 w. Min Wld—March 14, 1908. No. 90852.

Sir William E. Logan and the Geological Survey of Canada. Dr. Robert Bell. Gives incidents illustrating Sir Wm. Logan's important services to the Survey. 10700 w. Jour Can Min Inst—Vol. X, 1907. No. 91155 N.

Colorado.

The Historical Development of Colorado Viewed from a Geological Standpoint. T. A. Rickard. Ills. 2000 w. Min & Sci Pr—Feb. 29, 1908. No. 90709.

Earth Stresses.

The Earth a Failing Structure. John F. Hayford. Read before the Phil. Soc. of Washington. A study of the earth stresses, discussing whether it is an elastic or failing structure. 5500 w. Sci Am Sup—Feb. 22, 1908. No. 90589.

Graphite Crucibles.

Some Observations Upon the "Life" of Graphite Crucibles. Erwin S. Sperry. Gives an illustrated description of the appearance of a crucible after various heats when handled with care, and some of the causes of short life. 3800 w. Brass Wld—March, 1908. No. 91057.

Macedonia.

The Mineral Wealth of Macedonia. Extracts from an official report, which shows the country to be richly endowed with a large variety of minerals. 1200 w. Min Jour—Feb. 29, 1908. No. 90768 A.

Metallurgy.

Practical Metallurgy. Horace Allen. Gives a table showing the principal properties of various metals, discusses metallurgical processes, etc. 1000 w. Prac Engr—Feb. 21, 1908. Serial, 1st part. No. 90656 A.

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Metal Oxidation.

The Action of Oxygen on Metals. Edward Jordis and W. Rosenhaupt. Trans. from *Zeit. fuer Angewandte Chemie.* Gives results of experimental investigations. 2000 w. Sci Am Sup—March 7, 1908. No. 90718.

New Zealand.

The Mineral Wealth of New Zealand. Dr. J. Mackintosh Bell. Abstract of a paper read in London, Nov. 19, 1907, dealing with the economic geology of the Dominion. 4000 w. N Z Mines Rec—Jan. 16, 1908. No. 91007 B.

Ore Deposits.

Cerargyritic Ores: Their Genesis and Geology. Charles R. Keyes. Gives suggestive hypotheses accounting for the formation of these silver chloride ores in arid America. 2200 w. Ec Geol—Dec., 1907. No. 91044 D.

The Origin of Deposits of Pyrites. A. B. Willmott. Deals with occurrences in Ontario, reviewing the opinions of many writers and the important theories advanced. 4000 w. Jour Can Min Inst—Vol. X, 1907. No. 91150 N.

Present Tendencies in the Study of Ore Deposits. Waldemar Lindgren. Presidential address before the Geol. Soc. of Washington. Shows the tendencies of the studies of ore deposits during the last seven years. Also list of literature on this subject. 7000 w. Ec Geol—Dec., 1907. No. 91042 D.

A Theory of Ore-Deposition. J. E. Spurr. Gives a theory that proposes that metalliferous fluids are extreme differentiation phases of rock magmas; that most ore deposits represent extreme products of magmatic differentiation, and the differences are due to successive precipitations. 5000 w. Ec Geol—Dec., 1907. No. 91045 D.

A Theory of Ore-Deposition. Horace N. Winchell. An editorial letter discussing critically the theory recently advanced by J. E. Spurr. 2000 w. Min & Sci Pr—March 21, 1908. No. 91181.

The Paragenesis of Minerals, Particularly of the Zeolites (Ueber die Paragenese der Minerale, namentlich die der Zeolithe). F. Cornu. A discussion of the development and present form of the theory of paragenesis. 3200 w. Oest Zeitschr f Berg- u Hüttenwesen—Feb. 22, 1908. No. 90938 D.

See also New York, under IRON AND STEEL.

Peru.

The Mining Possibilities of the Department of Cuzco, Peru. Enrique J. Dueñas. Abstract translation. Describes this region and its mineral resources. 1800 w. Min Jour—March 7, 1908. Serial, 1st part. No. 90897 A.

Transportation, Costs and Labor in Central Peru. J. C. Pickering. Information concerning the railroads, labor conditions, etc. Ills. 2500 w. Eng & Min Jour—March 21, 1908. No. 91087.

Refractory Materials.

Refractory Materials. Thomas Holgate. A study of the nature of materials in their refractoriness to heat. 2500 w. Engng—Feb. 21, 1908. No. 90666 A.

United States.

Mineral Production of Western States, 1906-1907. A general review. 1907 shows an increase over 1906 of nearly $82,000,000. 15800 w. Min Sci—March 12, 1908. No. 90873.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Crossing Bells.

Large Installation of Crossing Bells, C., C., C. & St. L. Ry. Illustrated description of an extensive installation in Ohio, embodying new features in this branch of signal service. 2500 w. Ry & Engng Rev—March 14, 1908. No. 90857.

Headlights.

See same title, under MOTIVE POWER AND EQUIPMENT.

Signalling.

Railway Accidents and the Color Sense. George M. Stratton. On the danger from the use of white as a signal code at night; also discussing the green and red signals, and suggests the use of luminous lines in various positions. 3500 w. Pop Sci M—March, 1908. No. 90816 C.

See Subway Signalling, under STREET AND ELECTRIC RAILWAYS.

Signals.

Signals, Locking and Safety Devices on the Railways of the United States (Note sur les Signaux, Enclenchements et Appareils de Sécurité des Chemins de Fer des Etats-Unis). Ch. Jullien. A description of the various signalling methods and devices in use. Ills. 10000 w. Rev Gen des Chemins de Fer—Feb., 1908. No. 90911 G.

Interlocking Devices Installed at Valenciennes Station (Appareils d'Enclenchement Installés à la Gare de Valenciennes). A description of the Bianchi

and Servettas hydraulic system for the working of switches and signals. Ills. 3000 w. Génie Civil—Feb. 8, 1908. No. 90921 D.

See also Crossing Bells, under CONDUCTING TRANSPORTATION.

MOTIVE POWER AND EQUIPMENT.

Car Ferries.

See Ferryboats, under MARINE AND NAVAL ENGINEERING.

Car Heating.

Ventilation and Heating of Coaches and Sleeping Cars. Samuel G. Thompson. Describes the indirect system as used on the Pennsylvania R. R., outlining earlier types. Discussion follows. Ills. 13600 w. Pro W Ry Club—Feb. 18, 1908. No. 91041 C.

Car Lighting.

An Instantaneous Ignition Device for Gas Lamps under Test by the Eastern Railway of France (Note sur un Dispositif d'Allumage Instantané des Lanternes à Gaz à Incandescence Expérimenté à la Compagnie des Chemins de Fer de l'Est). E. Biard. Reviews previous attempts to solve the problem and illustrates and describes a new device. 5000 w. Rev Gen des Chemins de Fer—Feb., 1908. No. 90912 G.

Car Ventilation.

See Car Heating, under MOTIVE POWER AND EQUIPMENT.

Derrick Cars.

Derrick Cars for the Chicago, Milwaukee, & St. Paul. An illustrated detailed description of the heavy steel derrick car recently completed. 1500 w. Ry Age—March 13, 1908. No. 90855.

Dynamometer Cars.

A New Railway Dynamometer Car. Illustrated description of a car for testing the N.-E. Ry. Co.'s rolling stock, in England. 1000 w. Sci Am Sup—Feb. 8, 1908. No. 90582.

Electrification.

New York Central Electric Traction. C. H. Querean. Information in relation to the Initial Electric Zone, within the limits of Greater New York. 2000 w. Sib Jour of Engng—March, 1908. No. 91069 C.

The Value of Electrification as a Steam Railroad Improvement. Clarence P. Fowler. A plea for the single-phase system on the ground of economy. Editorial. 5000 w. Elec Wld—March 21, 1908. No. 91017.

Headlights.

Green Shade for Headlight. Describes the device, its working, and objects. 1200 w. Ry & Loc Engng—March, 1908. No. 90628 C.

Locomotive Performance.

Results Obtained in Service with the New, 4-Cylinder Compound Articulated Freight Locomotive of the Northern Railway of France (Résultats Obtenus en Service par les Nouvelles Locomotives Compound à Marchandises à 4 Cylindres et à 2 Bogies Moteurs de la Compagnie du Chemin de Fer du Nord). M. du Bousquet. Ills. 2200 w. Rev Gen des Chemins de Fer—Feb., 1908. No. 90910 G.

Locomotive Rating.

Tonnage Rating of Locomotives. B. A. Worthington. Outlines a simple and inexpensive system of engine rating that will give excellent results, and describes a more complete system that has been in use nine years on the Southern Pacific. General discussion. 13500 w. Pro Ry Club of Pittsburgh—Jan. 24, 1908. No. 91056 C.

Locomotive Repairing.

A Method of Repairing Cracked Piston Valve Cylinders. B. P. Flory. Describes a method lately adopted by the Central of New Jersey. Ills. 700 w. R R Gaz—Feb. 28, 1908. No. 90596.

Locomotives.

Four-Coupled Ten-Wheel Side-Tank Locomotive; L., B., and S. C. Railway. Plate, illustration and detailed description. 1500 w. Engng—Feb. 28, 1908. No. 90773 A.

Missouri & North Arkansas 2-8-0. Simple consolidation engines of this type, for freight service, are illustrated and described. 1000 w. Ry & Loc Engng—March, 1908. No. 90627 C.

L. and S. W. Locomotive No. 335. Elevation and sections, with description of details. 300 w. Engr, Lond—Feb. 21, 1908. No. 90673 A.

Ten-Wheel Passenger Locomotives for the St. Louis and San Francisco. Illustrated detailed description of these heavy engines. 500 w. Ry Age—March 6, 1908. No. 90754.

New Locomotives for the Atchison, Topeka & Santa Fe. Illustrated descriptions of Pacific engines for passenger service, and consolidation engines for freight service. 900 w. R R Gaz—March 27, 1908. No. 91256.

Locomotives with Low Boiler Pressure and Smokebox Superheaters. Illustrates and describes engines for the A., T. & S. F. Ry. 1000 w. Am Engr & R R Jour—March, 1908. No. 90637 C.

Express Locomotives—State Railroads of Sweden. Illustrated description of a recently built engine designed to meet the increased requirements. Also report of tests. 2500 w. R R Gaz—Feb. 28, 1908. No. 90595.

Balanced Compound Locomotive with Superheater for the Pfaelz Railways. Illustrated detailed description of an en-

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gine of recent construction, used in Germany. 1500 w. Ry Age—Feb. 28, 1908. No. 90594.

Some Examples from Recent Italian Locomotive Practice. Illustrated descriptions of recent designs of locomotives of the 6-wheeled coupled type. 2200 w. Mech Engr—March 6, 1908. No. 90885 A.

The First Superheating Locomotive of the Italian State Railways (Le Prime Locomotive a Vapore Surriscaldato delle Ferrovie di Stato Italiane). Illustrated description. 2500 w. Serial, 1st part. Ing Ferroviaria—Feb. 16, 1908. No. 90928 D.

Locomotive Stacks.

Locomotive Smoke Stacks. W. E. Johnston. Presents the development of new formulæ for stack diameters, using the data obtained in the tests of 1896, 1903 and 1906 as a basis. 800 w. Am Engr & R R Jour—March, 1908. No. 90635 C.

Speed Indicators.

The Flaman Speed Indicator and Recorder for Locomotives. Illustrates and describes this device and its application to locomotives on the Eastern Railway of France. 2000 w. Mech Engr—March 13, 1908. No. 91130 A.

Train Heating.

Train Heating on Electric Divisions of Steam Railroads. Charles M. Ripley. Describes the two methods adapted to the rolling stock of the New York Central and of the New Haven R. R. Ills. 1200 w. R R Gaz—March 13, 1908. No. 90871.

Train Lighting.

See D. C. Dynamos, under ELECTRICAL ENGINEERING, DYNAMOS AND MOTORS.

Train Resistance.

The Resistance of Railway Trains, and the Formulæ Used for Calculating It. Albert Frank. Compares the principal formulæ now used, considering the experiments which led to their determination. 6700 w. Bul Int Ry Cong—Feb., 1908. No. 91214 G.

Valve Gears.

Walschaert Valve Gear for Pacific Type Locomotive. Illustrates and describes the method of applying this gear on engines for the Florida East Coast R. R., commending the arrangements. 1000 w. Am Engr & R R Jour—March, 1908. No. 90636 C.

NEW PROJECTS.

Illinois Central.

The Illinois Central's Birmingham Line. Map and illustrated description of this new line. 2500 w. R R Gaz—March 13, 1908. No. 90869.

Memphis and State Line Railroad. Illustrated detailed description of a new line for handling heavy through traffic, avoiding grade crossings and heavy gradients which are serious hindrances on the main line. 1400 w. Ry Age—Feb. 28, 1908. No. 90593.

Lake Shore.

Vanderbilt Operations in Pennsylvania. Map and description of a new cut-off line from Franklin to Clearfield, in the bituminous coal regions. 1500 w. Ry Age—March 20, 1908. No. 91098.

PERMANENT WAY AND BUILDINGS.

Bridge Deflection.

The Osske-Kühne Deflection Recorder and the Utilization of Railway Bridge Records Obtained with It. Mr. Jaehn. Ills. 2000 w. Bul Int Ry Cong—Feb., 1908. No. 91212 G.

Coaling Plants.

Coaling Stations on the Belen Cut-Off. Illustrated description of stations in New Mexico. 800 w. R R Gaz—March 13, 1908. No. 90864.

Construction.

Building a Railway Embankment by the Hydraulic Method. George H. Moore. Describes the construction of what is said to be the largest railway embankment in the world, being built in the State of Washington. Ills. 1000 w. Eng News—March 12, 1908. No. 90791.

See also Gauge Conversion, under PERMANENT WAY AND BUILDINGS.

Crossings.

The Proposed Elimination of Grade Crossings at Worcester, Mass. Charles B. Breed. An explanation of the difficult problem in this city and the method of solving it. Ills. 3500 w. R R Gaz—March 13, 1908. No. 90868.

See also Crossing Bells, under CONDUCTING TRANSPORTATION.

Curves.

Curve Superelevation. M. L. Byers. A mathematical study of proper speeds and elevations. 2200 w. R R Gaz—March 13, 1908. No. 90870.

See also Track Maintenance, under PERMANENT WAY AND BUILDINGS.

Drop Pits.

Southern Pacific Drop Pit. Illustrated detailed description of this roundhouse appliance. 1000 w. Ry & Loc Engng—March, 1908. No. 90626 C.

Freight Sheds.

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION; and Cranes, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Gauge Conversion.

Railway Gauge Conversion in Manchuria. Illustrates and describes the work of gauge widening without serious inter-

ruption of traffic. 1000 w. Engr, Lond —March 6, 1908. No. 91004 A.

Maintenance of Way.

Reports and Discussions, Maintenance of Way Association. 25000 w. Ry Age —March 20, 1908. No. 91148.

Rails.

Strength and Endurance of Steel Rails. James E. Howard. Read before the Am. Ry. Engng. & Main. of Way Assn. Remarks on the conditions and influences which contribute toward fracture as shown by tests. Discussion. Ills. 5000 w. Ry Age—March 20, 1908. No. 91103.

Reconstruction.

Rebuilding the Northern Pacific in Minnesota. H. Cole Estep. Illustrates and describes interesting work including double-tracking, reballasting, grade reductions and modifications of alinement. 2000 w. R R Gaz—March 13, 1908. No. 90867.

Roundhouses.

Engine Houses of North American Railways (Lokomotivstationen nordamerikanischer Eisenbahnen). Herrn Blum and E. Giese. The first part of the serial discusses shops and coaling plants. Ills. 3300 w. Serial, 1st part. Zeitschr d Ver Deutscher Ing—Feb. 8, 1908. No. 90975 D.

See also Terminals, under PERMANENT WAY AND STRUCTURES.

Shops.

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

Stations.

Station Standards; Virginian Railway. Illustrated detailed description of the standardized designs adopted for the States of Virginia and West Virginia on this line. 4000 w. R R Gaz—March 13, 1908. No. 90865.

Terminals.

Union Terminal at Washington, D. C. —Locomotive Terminal. Plan and illustrated description of the locomotive terminal, which provides storage for a large number of locomotives and complete facilities for cleaning and coaling. 1500 w. Ry Age—March 20, 1908. No. 91097.

Union Terminal at Washington, D. C.—Coach Terminal. Illustrates and describes the principal features of the coach terminal yards. 700 w. Ry Age—March 27, 1908. No. 91254.

Terminal Improvements at Ashtabula Harbor for the Pennsylvania Lines. Illustrates and describes improved facilities for handling coal and ore at this Lake Erie port. 600 w. Ry & Engng Rev—March 14, 1908. No. 90856.

Ties.

Australian Timbers for Cross Ties. C. O. Burge. Information concerning the quantity, quality and cost of the timber available. 2200 w. Eng Rec—March 21, 1908. No. 91085.

The Steel Tie (Die Eisenschwelle). A. Haarmann. A discussion of the development of permanent way construction with the increase in traffic and the efficiency of the steel tie, illustrating and describing various types. 9000 w. Stahl u Eisen —Feb. 5, 1908. No. 90931 D.

Track Maintenance.

Maintenance of Tracks at Curves. H. Saller. On the use of the sagitta method for determining whether rails are right. 1700 w. 2 tables. Bul Int Ry Cong—Feb., 1908. No. 91213 G.

Water Tanks.

Railroad Track Tanks. H. H. Ross. Illustrates and describes the details of tank systems, giving results of tests, and discussing matters relating to their efficiency. 3000 w. R R Gaz—March 13, 1908. No. 90862.

Yards.

The Sunnyside Yard of the Pennsylvania. F. H. Shakespeare: An illustrated detailed description of this new terminal yard on Long Island, and its facilities. 4500 w. R R Gaz—March 13, 1908. No. 90863.

Hump Yards and Terminals. From a committee report to the Am. Ry. Engng. & Main. of Way Assn. on the design of hump yards and giving illustrated descriptions of several yards and their operation. 9000 w. Ry & Engng Rev—March 21, 1908. No. 91095.

TRAFFIC.

Freight.

The Reform of the Goods Traffic on the Prussian State Railways. Mr. Schwabe. On increasing the capacity of the wagons, and accelerating their circulation. Ills. 4000 w. Bul Int Ry Cong—Feb., 1908. No. 91215 G.

Passenger Tariffs.

The Results of the Reform in the Passenger Tariff in Germany. Discusses the results since the new rates went into effect. 4400 w. Bul Int Ry Cong—Feb., 1908. No. 91216 C.

MISCELLANY.

Accounting.

Notes on the Application of a Depreciation Charge in Railway Accounting. Frederic A. Delano. A careful consideration of methods of dealing with this subject which have developed in the United States and Great Britain, with criticism of the proposed rules. 3300 w. Ry Age—March 27, 1908. No. 91255.

Africa.

Lessons of the Daressalam-Morogoro Railway (Was können wir aus dem Bahn-

We supply copies of these articles. See page 322.

bau Daressalam-Morogoro lernen). Herr Schubert. A description of the construction of this line in German East Africa. Ills. 9000 w. Glasers Ann—Feb. 1, 1908. No. 90956 D.

The Otavi Narrow-Gauge Railway in German South-West Africa (Die Otavi Schmalspurbahn im Deutschen Schutzgebiete Deutsch-Südwestafrika). E. A. Ziffer. A description of the line, its construction, operation, etc. Ills. 7000 w. Mit d Ver f d Förd d Lokal u Strassenbahnwesens—Jan., 1908. No. 90930 F.

Forestry.

I. Review of Forestry Experiments by American Railways. R. C. Bryant. An interesting account of these undertakings. II. Forest Work of the Pennsylvania Railroad. E. A. Sterling. An account of the commercial project, aiming to supply crossties and fence posts by the planting of forest trees on the company's lands. 4000 w. Ry Age—March 20, 1908. No. 91100.

History.

Some Early American Railroad Engineers. O. F. Nichols. An interesting review of the engineers who built the first railroads in America, the early engines, the canals, and other works. Photographs. 10500 w. Pro Brooklyn Engrs Club, No. 72—Vol. XI, 1907. No. 91236 N.

Newfoundland.

The Railroad System of Newfoundland. Illustrated account of railroad system and its equipment. 1600 w. R R Gaz—March 6, 1908. No. 90724.

Norfolk & Southern.

Growth of the Norfolk & Southern System. Describes the region served by this road, and the present lines of the system, and new construction. Maps. 2500 w. Ry Age—March 20, 1908. No. 91096.

Purchasing.

The Purchasing Department of a Railway System and the Importance of Co-operation Among Different Departments of the Service in Intelligently Standardizing Many of the Articles to be Purchased. W. V. S. Thorne. Describes the present practice and policy of the Union Pacific and Southern Pacific Systems. Discussion. 16800 w. Pro N Y R R Club—Feb. 21, 1908. No. 91055.

STREET AND ELECTRIC RAILWAYS

Accounting.

The Small Company and the New Classification of Accounts. W. B. Brockway. Concerning the classification proposed by the Interstate Commerce Commission, criticising points affecting electric railways. 3800 w. St Ry Jour—March 14, 1908. No. 90815.

Berlin.

Recent Extensions on the Berlin Hoch- und Untergrundbahn. Illustrates and describes the equipment of a large sub-station, and also the cars used. 3000 w. Elect'n, Lond—March 13, 1908. No. 91135 A.

Brooklyn.

Improvement of the Brighton Beach Line—Brooklyn Heights Railroad Company. Harry B. Snell. An illustrated detailed description of the methods used in the extensive work of depressing and elevating tracks, and construction work generally. Discussion. 6500 w. Pro Brooklyn Engrs Club, No. 75—Vol. XI, 1907. No. 91239 N.

Canal Traction.

See Canal Haulage, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Car Department.

The Car Equipment Department of the Interborough Rapid Transit Company—General Considerations and Analysis of Inspection Reports. 4500 w. St Ry Jour—March 28, 1908. No. 91186.

Cars.

See Berlin, Trucks, and Subway Cars, under STREET AND ELECTRIC RAILWAYS.

Controllers.

The Contractor and Reverser. W. B. Kouwenhoven. Illustrates and describes these devices as used on the Manhattan Elevated Ry., and their operation. 1200 w. Ry & Loc Engng—March, 1908. No. 90629 C.

Electrification.

See same title, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Elevated Railways.

The Kemwood and Stock Yards Extension of the Chicago South Side Elevated Railroad. An illustrated detailed description of these new lines. 3000 w. St Ry Jour—March 7, 1908. No. 90717.

Great Britain.

Electrical Installations in Great Britain (Les Installations Electriques en Grande-Bretagne). Discusses the present status of electric traction. 3300 w. Serial. 1st part. Génie Civil—Feb. 29, 1908. No. 90927 D.

Interurban.

The Boise & Interurban Railway. Illus-

We supply copies of these articles. See page 322.

trated description of a line recently put in operation in Idaho. 1500 w. Elec Ry Rev—March 14, 1908. No. 90872.

The Northern Electric Street Railway Company of Scranton, Pa. Illustrated detailed description of a line now operated between Scranton and Factoryville, and the proposed extensions. 3000 w St Ry Jour—March 21, 1908. No. 91033.

See also Single Phase, under STREET AND ELECTRIC RAILWAYS.

London.

See Subways and Surface Contact, under STREET AND ELECTRIC RAILWAYS.

Motors.

See Railway Motors, under ELECTRICAL ENGINEERING, DYNAMOS AND MOTORS.

Single Phase.

Richmond & Chesapeake Bay Single-Phase Railway. Illustrated detailed description of the line and its equipment. 5000 w. St Ry Jour—March 7, 1908. No. 90716.

The Hanover & York Single-Phase Railway. An illustrated description of a new 20-mile single-track line in Pennsylvania, and its operation. 1500 w. Elec Ry Rev—March 7, 1908. No. 90745.

Pittsburg & Butler Single-Phase Railway. L. H. Kidder. Illustrated detailed description of a heavy interurban line of first-class construction. 5500 w. Elec Jour—March, 1908. No. 90795.

The Rome-Civita Castellana Electric Railway. Illustrated detailed description of the first single-phase line built in Italy. 3000 w. Tram & Ry Wld—March 5, 1908. No. 91128 B.

The Maggia Valley Railway (Die Valle Maggia-Bahn). Illustrated description of the line and equipment of this railway between Locarno and Bignasco, Switzerland. 1000 w. Serial. 1st part. Schweiz Bau—Feb. 1, 1908. No. 90947 D.

The Finzi System of Single-Phase Alternating-Current Electric Traction on European Railways (La Traction Electrique par Courant Alternatif Simple sur les Chemins de Fer en Europe). M. Henry. Describes the system and the lines on which it is in use. Ills. 2000 w. Elec'n —Feb. 8, 1908. No. 90913 D.

See also Electrification, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Subway Cars.

Improved Steel Cars for the New York Subway. Illustrated description of new features introduced. 1200 w. St Ry Jour —March 14, 1908. No. 90814.

The Subway Car. Part of the report of Bion J. Arnold discussing the various types of cars which can be used in rapid transit work and the arrangements of seats. Diagrams. 8000 w. R R Gaz—March 6, 1908. No. 90723.

Types of Rapid-Transit Car for Maximum Service. A summary of the arguments of Bion J. Arnold in regard to suggested types, presenting various designs. 2500 w. Eng News—March 5, 1908. No. 90697.

Subways.

The Strand to Embankment Subway. A criticism of this undertaking, with a description of its engineering features. Plate & Ills. 4000 w. Engr, Lond—March 13, 1908. No. 91143 A.

The Aldwych-Embankment L. C. C. Tramway Subway. Illustrated description of this connection of the northern and southern portion of the tramway system of London. 1500 w. Elec Engng—March 5, 1908. No. 90888 A.

Underground and Tube Railways of London, England. S. A. Ionides. Explains the conditions which led to their adoption, and briefly describes the methods of construction. Ills. 1800 w. Min Sci—March 19, 1908. No. 91114.

The United States Capital Subways. W. J. Knight. Illustrated detailed description of the reinforced concrete subways conecting the Capitol with the Senate and House office buildings. 2000 w. Eng Rec —March 21, 1908. No. 91081.

Subway Signalling.

The Signal System of the Interborough Subway. Gives improvements recommended by Bion J. Arnold. 1500 w. R R Gaz —March 20, 1908. No. 91076.

Subway Ventilation.

The Relation Between the Iron Superstructure of Tunnels and Their Artificial Ventilation (Zum Verhalten des eisernen Oberbaues in Tunnelanlagen und deren Künstliche Entlüftung). G. Steuer and M. Jäger. A discussion of the effects of tunnel air on iron construction and the necessity of efficient ventilation. Ills. 2500 w. Serial. 1st part. Elektrotech Rundschau—Feb. 5, 1908. No. 90950 D.

Surface Contact.

The Griffiths-Bedell Surface-Contact System in London. Illustrates and describes the line from Aldgate to Bow. Ills. 3000 w. Tram & Ry Wld—March 5, 1908. No. 91129 B.

Track Maintenance.

See Trucks, under STREET AND ELECTRIC RAILWAYS.

Trucks.

Trucks and Permanent Way Maintenance. F. W. Leevers. A brief discussion of the relationship a good truck bears to the economical maintenance of permanent way. 1200 w. Elec Rev, Lond—March 13, 1908. No. 91134 A.

We supply copies of these articles. See page 322.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated: W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin du Lab. d'Essais. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Clay Record. *s-m.* Chicago.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.

Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Review. *w.* Chicago.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Chicago.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingeniería. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *w.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* London.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Science. *w.* Denver, U. S. A.
Mining World. *w.* Chicago.
Mittheilungen des Vereines für die Fôrderung des Local und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *b-m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Public Works. *qr.* London.
Quarry *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista Tech. Ind. *m.* Barcelona.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Rivista Gen. d Ferrovie *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Street Railway Journal. *w.* New York.
Surveyor *w.* London.
Technology Quarterly. *qr.* Boston, U. S. A.
Technik und Wirtschaft. *m.* Berlin.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagon Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Decoration.

Decoration of Metal, Wood, Glass, Etc. Edited by H. C. Standage. Size, 7½ by 5 in.; pp. 228. Price, $2, 8/6. New York: John Wiley & Sons; London: Chapman & Hall, Ltd.

Described as "a Book for Manufacturers, Mechanics, Painters, Decorators, and all Workmen in the Fancy Trades." It is a collection of recipes, assembled apparently without discrimination from all kinds of sources, intelligent and otherwise. Some, indeed, might have been gathered from the flotsam which drifts about the sea of the "exchanges" until it is battered out of all semblance of meaning. A few are addressed to the intelligence of the schoolboy; many would need to be supplemenetd by such knowledge of the art that the recipe would be superfluous. The best that can be said, perhaps, is that in spite of its incoherence the book does contain matter of usefulness and value.

Dictionary.

Illustrated Technical Dictionary in Six Languages, English, German, French, Russian, Italian and Spanish. Edited by K. Deinhardt and A. Schlomann. Vol. II, Electrical Engineering. Size, 7 by 4 in.; pp., 2100. Ills. Price, $7. New York: McGraw Publishing Company; London: Archibald Constable & Co.

Mention was made in these columns some months ago of the appearance of Volume I of this dictionary, covering machine details and tools. Our experience with the first volume leads us heartily to welcome the appearance of the second and to await with a considerable degree of impatience the remaining eight volumes which are projected for the completed work. The editing of the two volumes at present available has been most carefully done and such errors as might be expected to creep into a work of this magnitude are remarkably infrequent. The unique arrangement of the dictionary, the placing, wherever possible, of the equivalent terms in the six languages side by side with a small illustration of the device to which they refer, is a most commendable feature. The sixteen parts into which the present volume is divided deal with cells and batteries; boilers and prime movers; electrical machinery; switch apparatus; measuring instruments; electric supply stations; mains; wiring; lighting; various applications of electricity; telegraphy; telephony; electro-chemistry; electro-medical apparatus; electrical units; and an appendix. Electric traction is reserved for a subsequent volume on railway engineering.

Electrical Engineering.

An Introduction to the Study of Electrical Engineering. By Henry H. Norris. Size, 9 by 6 in.; pp., 404. Ills., 179. Price, $2.50, 10/6. New York: John Wiley & Sons; London: Chapman and Hall, Limited.

Prof. Norris defines electrical engineering as the industrial application of magnetic and electrical principles. He believes that the student in approaching the subject should have personal knowledge of the things and phenomena involved before any reasons can be assigned to them. The plan of the present work is, therefore, to take the every-day experience of the student as the basis of a general survey of electrical applications and, by combining with this experience the lessons taught by scientific research, to give a clear conception of electrical laws which may then be used to explain the operation of the numerous devices used in electrical practice. The work is mainly descriptive and, as its title implies, it is intended to serve only as an introduction to the more advanced knowledge required by the specialist in electrical engineering.

An Introductory Course of Continuous Current Engineering. By Alfred Hay. Size, 8½ by 5½ in.; pp., 327. Ills. Price, $2.50. New York: D. Van Nostrand Company.

Within the limits which the author has set for himself, this work is a very clear and useful exposition of the principles of direct-current engineering. It is introductory in the sense that, while the treatment presupposes an elementary knowledge of magnetism and electricity, the scope of the work is restricted to a simple account of the construction and operation of the component parts of a continuous-current lighting and power plant, without reference to their selection and arrangement to form a connected system. The author does not claim to have ex-

hausted even this part of the subject but no information which could properly be included in an elementary treatise of this kind has been slighted. The material is very logically arranged and the many illustrations in the text assist materially in the clearness of its presentation. The book can confidently be recommended as a reliable and useful handbook.

Standard Handbook for Electrical Engineers. Written and Compiled by a Staff of Specialists. Size, 7 by 4 in.; pp., xx, 1283. Ills., 1260. Price, $4. New York: McGraw Publishing Company.

In the preparation of this latest addition to the list of electrical-engineering handbooks, the whole field of electrical engineering was divided into twenty sections and each section is treated separately by a specialist in the particular subjects covered by its title. The arrangement of the book follows the following general order: Fundamental theory, materials, apparatus, generation plants, transmission and distribution plants, utilization of electrical energy, standard practice and miscellaneous electrical information. In reality there are twenty books bound in one volume, each intended to be a complete and separate treatise on one particular section of electrical engineering but carefully edited according to a uniform style and thoroughly interconnected by cross references through a single index. The editing has apparently been very carefully done and the confusion and unnecessary repetition which might have been expected to result from this system of compilation seem to have been succesfully avoided. The most commendable feature of the book is that it is thoroughly up-to-date and contains much information on the later developments and applications of electrical science not usually found in similar handbooks.

Experimental Electrical Engineering and Manual for Electric Testing. By V. Karapetoff. Size, 9 by 6 in.; pp., xxxiv, 790. Ills., 538. Price, $6, 25/6. New York: John Wiley & Sons; London: Chapman and Hall, Limited.

A thorough and complete manual for electrical testing, covering in its 35 chapters the whole series of tests usually made by electrical engineering students during the last two years of their college course, as well as many others connected with the commercial applications of electricity, which are not usually found in manuals of this kind. In addition to the usual tests of generators, motors and transformers, complete and accurate outlines are given of tests of measuring instruments, transmission circuits, accumulators, electric heaters and welders, arc and incandescent lamps, railway controllers and telephone instruments. In still another feature has the author departed from the usual practice in laboratory manuals, in devoting considerable space to the description of the various types of machines and appliances. This descriptive matter will increase the value of the manual for laboratory use, for, while it in no way relieves the student of responsibility, it assists him to a clear understanding of the theory of the machine under test and ensures the most effective performance of the actual experimental work. In the preface, Prof. Karapetoff advocates the "concentric" method of teaching electrical engineering, but his book is so arranged as to satisfy the requirements of any schedule or any distribution of equipment.

Electric Lighting.

A Compilation of the Records of the Colorado Springs Lighting Controversy with an Introduction and Epitome. By Henry Floy. Size, 9 by 6 in.; pp., 327. Ills. Price, $4. New York: Illuminating Engineering Publishing Company.

The litigation in this case between the City of Colorado Springs and the Pike's Peak Hydro-Electric Company centred principally about three points, namely, the meaning of the phrase "an arc light of standard 2,000 candle power"; the monetary damage accruing by the substitution of a 6.6 ampere series alternating-current arc lamp for "an arc lamp of standard 2,000 candle power"; and the financial damage resulting from the failure to maintain the substituted lamps at their normal operating conditions. The judicial settlement of these points for the first time makes the case one of the most interesting and important that has arisen in connection with electric-lighting contracts. The records of the case, which occupy the greater part of the present volume, are a remarkably valuable contribution to the literature of arc lighting, since they present the opinions of a number of experts and authorities of the highest standing on a large variety of subjects of technical and commercial importance. Mr. Floy's introduction and his analysis of the testimony and award contain a great deal of excellent advice on the form of agreements for municipal electric lighting contracts, which central station managers would do well to follow. The book should be welcomed by electric-lighting engineers as ensuring the availability and permanence of a large amount of useful information on the legal, technical and commercial aspects of their work.

Electro-Metallurgy.

The Electric Furnace, its Evolution, Theory and Practice. By Alfred Stansfield. Size, 9 by 6 in.; pp., 211. Ills.

Price, $2. Toronto: The Canadian Engineer; New York and London: Hill Publishing Company.

A clear presentation of the theory and development of electric smelting has been needed for some time and Dr. Stansfield's present work fulfils its purpose admirably. It does not pretend to be an exhaustive treatise or to describe all the electric furnaces that have been invented. Its purpose is "to set forth clearly the fundamental principles of this form of furnace; to show its various uses; to indicate its limitations; and, if possible to be of some assistance to those who wish to design electric furnaces, or to judge of the feasibility of schemes involving their use." The book is divided into seven chapters, dealing, respectively, with the history of the electric furnace; a description and classification of the various types; the efficiency of electric and other furnaces and the relative cost of electrical and fuel heat; electric furnace design, construction and operation; the production of iron and steel in the electric furnace; the use of the electric furnace for the production of ferro-alloys, graphite and other carbides, for zinc smelting, and for other miscellaneous uses; and an estimate of the future possibilities in the development of the electric furnace and electro-thermic processes. Within its scope the work is admirably conceived and executed and has the additional merit of being thoroughly up-to-date.

Hydraulics.

A Treatise on Hydraulics. By William Cawthorne Unwin. Size, 8½ by 5½ in.; pp., 327. Ills. Price, $4.25. New York: The Macmillan Company; London: Adam and Charles Black.

This treatise on hydraulics is marked by the clearness and conciseness which engineers have come to expect in works from Prof. Unwin's pen, and his long connection with the subject, as a teacher and as an original investigator, gives the work a distinction rarely met with during the present period of over-production of technical books. Prof. Unwin recognizes that strictly rational hydrodynamics gives very little assistance to the engineer, since its theoretical results are flagrantly at variance with the behavior of actual fluids. In dealing with practical problems the engineer has to resort to empirical formulae, the data for which have been accumulating over a period of two centuries. These data are of very varying trustworthiness and importance and their uncertainties seem to Prof. Unwin to constitute the great difficulty in the solution of hydraulic problems. His treatment of the subject, therefore, aims to give a sufficient account of experimental investigations to enable the student to realize the limitations of formulae and the degree of confidence which can be placed in calculations without getting involved in a cumbrous and confusing amount of empirical details. Such a treatment in Prof. Unwin's well-known style will be heartily welcomed by engineers.

Index.

The Engineering Index Annual for 1907. Compiled from The Engineering Index published monthly in THE ENGINEERING MAGAZINE. Size, 9½ by 6¾ in.; pp., 435. Price, $2.00, 10/. New York: London: THE ENGINEERING MAGAZINE.

With this volume—the sixth since the work was first undertaken and the second since it assumed annual in place of triennial or quinquennial form—a continuous index to the engineering and technical literature of the past twenty-four years is made available to the reader. Like the 1906 Annual, this book retains the classification of all entries under the recognized great divisions of Engineering—Civil, Mechanical, Mining, Electrical, etc.—as preliminary to alphabetic arrangement by subject catchwords; but it shows the result of great additional editorial care in generous cross-referencing, in the standardization of catchwords, and in the close assembling of like entries under the more comprehensive catchwords, as (for example) "Locomotive". The classification also is in many respects amplified and clarified. And appearance early in the year, while the literature indexed is still timely and easily accessible, is no slight addition to the value of a reference work of this sort.

Gas Power.

Gas Power. By F. E. Junge. Size, 9 by 6 in.; pp., 548. Ills. Price, $5, 21/. New York and London: Hill Publishing Company.

This is unquestionably one of the most important contributions to the literature of gas power that has appeared in English in some time. In its economic treatment of the subject it may fairly be said to be the most important. Other works have for the most part been devoted to one of three aims: the abstract study of the internal thermodynamic relations of gas producing and converting apparatus; the quantitative design of their mechanism; or the historical or inventive evolution of the problem. Mr. Junge combines with a survey of present developments in these important and interesting aspects of the problem, a discussion of the application of gas power, which places his book in a class by itself for which it is likely to set the standard for some time to come. The book is divided into three parts. The first, on the evolution of gas power, devotes two chapters to the general aspects of the problem and a historical and analytical study of the development, and

criticism of the present mode of application, of gas power. The second part deals with the design and construction of large gas engines, a discussion of many standard types being introduced by a chapter on the general principles of design. The concluding section of the book discusses the application of gas power in the iron and steel industries and in the coal mining and coke making industries, and the rational utilization of low-grade fuels. As a condensed record of the experiences and achievements of European engineers in this important field the book should prove of inestimable service in England and America where the economic conditions which made necessary the rapid development of gas power on the Continent, especially in Germany, are beginning to make themselves felt.

Metallurgy.

The Metallurgy of Iron and Steel. By Bradley Stoughton. Size, 9 by 6 in.; pp., 509. Ills. Price, $3. New York and London: Hill Publishing Company.

As a descriptive treatise on the various processes in modern American iron and steel manufacture this book will unquestionably take a foremost place. Nothing of importance has been omitted and the processes and principles are described and explained with clearness and conciseness and with fair accuracy. In explaining general chemical, physical and mechanical principles, however, the author is less happy. Some of the faults seem to be due to carelessness, but in some few cases the explanations given are fundamentally inaccurate. These minor defects do not, however, seriously impair the value of the work as a text book for the beginner and as a general reference book for the specialist in other branches of engineering. It will not displace any of the older, established treatises on the subject, but it will fulfil, most acceptably, an important supplementary function.

Physics.

Practical Physics, a Laboratory Manual for Colleges and Technical Schools. By W. S. Franklin, C. M. Crawford and Barry MacNutt. In 3 volumes: Vol. I, Precise Measurements in Mechanics and Heat; Vol. II, Elementary and Advanced Measurements in Electricity and Magnetism; Vol. III, Photometry and Experiments in Light and Sound. Size, 8½ by 5½ in.; pp., Vol. I, 176; Vol. II, 160; Vol. III, 80. Ills. Price, Vols. I and II, $1.25 each; Vol. III, 90 cents. New York: The Macmillan Company; London: Macmillan & Co., Limited.

The authors believe that a laboratory manual for the teaching of physical science should set forth a series of definite exercises. Hence the volumes in hand are a collection of more or less theoretical problems which the student is required to solve by means of experimental data which he himself obtains. The ground covered is about that of the first year's work in physics in an engineering school. The explanations and instructions are very clear and, so far as it goes, the work would no doubt be found a useful guide in laboratory teaching.

Plans.

How to Read Plans. By Charles G. Peker. Size, 7½ by 5 in.; pp., 46. Ills. Price, 50 cents. New York: Industrial Publication Co.

A book for the building mechanic. The author admits that the best way to learn to read plans is to learn to draw, but this book is offered as a manual of self help for such as have not the necessary time to devote to the study of drawing. The meaning of the various parts of a building drawing, plans, elevations, sections, etc., and the conventional symbols used in drafting are explained in simple language and with the use of many illustrations. A full set of working plans for a small frame house is given at the end of the volume, so that the student is enabled to study the subject with reference to conditions he is likely to meet in his daily work. The book would no doubt be of great value to men in the building trades and it would also form a useful part of the equipment of the beginner in architectural drafting.

Works Management.

Profit Making in Shop and Factory Management. Charles U. Carpenter. Size, 8½ by 6 in.; pp., 146. Price, $2, 10/6. New York: London: THE ENGINEERING MAGAZINE.

Perhaps the most significant of all professional literature is that in which men of action, who have been successful in carrying out work large in possibilities and extremely useful as precedent, put their own personality into the description of the way it was done. This is substantially what the author accomplishes in this instance. Mr. Carpenter for years has been constantly in the very heat of the struggle for economy and efficiency, and ever better economy and efficiency, in mechanical production. As superintendent, manager, director, president, of large manufacturing concerns, he is living daily amid the operation of the methods, the processes, the policies with which his book is concerned. Every chapter is vibrant with the daily life of the shop, and with triumphant progress toward conditions of greater profit to the manufacturer and greater contentment for the workman. The book is thoroughly practical in every part, and its suggestions as useful to the small shop employing ten men as to the great works employing thousands.

BOOKS RECEIVED.

Report of the Committee on Education, January, 1908. Size, 9 by 6 in.; pp., 72. Syracuse, N. Y.: Syracuse Chamber of Commerce.

Le Perou d'Aujourd'hui et le Perou de Demain. By Emile Guarini. Size, 9½ by 6½ in.; pp., 16. Price, 1 franc. Paris: Dunod & Pinat.

Les Merveilles de l'Electrochimie. By Emile Guarini. Size, 9½ by 6½ in.; pp., 168. Ills., 99. Price, 5 francs. Paris: Dunod & Pinat.

The Copper Handbook, Vol. VII, 1907. By Horace J. Stevens. Size, 9 by 6 in.; pp., 1228. Price, $5. Houghton, Mich.: Horace J. Stevens.

Steam-Electric Power Plants. By Frank Koester. Size, 10½ by 7½ in.; pp., xviii, 455. Ills. Price, $5. New York: D. Van Nostrand Company.

Safe Building Construction. By Louis de Coppet Bergh. Size, 8 by 5 in.; pp., xvi, 436. Ills. Price, $5. New York: The Macmillan Company.

Simple Mine Accounting. By David Wallace. Size 9 by 6 in.; pp., 63. Ills. Price, $1. New York and London: Hill Publishing Company.

Hydraulic Engineering. By Gardner D. Hiscox. Size, 9 by 6 in.; pp., 315. Ills. Price, $4. New York: The Norman W. Henley Publishing Company.

Engineering Reminiscences. By Charles T. Porter. Size, 9 by 6 in.; pp., 335. Ills. Price, $3, 12/6. New York: John Wiley & Sons; London: Chapman & Hall.

Practical Steam and Hot Water Heating. By Alfred G. King. Size, 9 by 6 in.; pp., 402. Ills. Price, $3. New York: The Norman W. Henley Publishing Company.

Modern Pigments and Their Vehicles. By Frederick Maire. Size, 8 by 5 in.; pp., xi, 266. Price, $2, 8/6. New York: John Wiley & Sons; London: Chapman & Hall.

Arithmetic of Electrical Engineering. Size, 7½ by 5 in.; pp., 159. Ills. Price, 50 cents, 1/. New York: The Macmillan Company; London: Whittaker & Company.

Le Catalogue International des Principales Publications Périodiques du Monde. By Emile Guarini. Size, 9½ by 6½ in.; pp., 75. Price, 3 francs. Paris: Dunod & Pinat.

The Gas Engine. By Frederick Remsen Hutton. Third Edition. Size, 9 by 6 in.; pp., xx, 562. Ills. Price, $5, 21/. New York: John Wiley & Sons; London: Chapman & Hall.

Power and Power Transmission. By E. W. Kerr. Second Edition. Size, 9 by 6 in.; pp., xiv, 366. Ills. Price, $2, 8/6. New York: John Wiley & Sons; London: Chapman & Hall.

Development and Electrical Distribution of Water Power. By Lamar Lyndon. Size, 9 by 6 in.; pp., 317. Ills. Price, $3, 12/6. New York: John Wiley & Sons; London: Chapman & Hall.

The Elements of Railroad Engineering. By William G. Raymond. Size, 9 by 6 in.; pp., xvi, 405. Ills. Price, $3.50, 15/. New York: John Wiley & Sons; London: Chapman & Hall.

Handbook for the Care and Operation of Naval Machinery. By Lieut. H. C. Dinger, U. S. Navy. Size, 6½ by 4½ in.; pp., 302. Ills. Price, $2. New York: D. Van Nostrand Company.

Seventh Annual Report of the Commissioner of Labor for the Twelve Months Ended September 30, 1907. Size, 9 by 6 in.; pp., 272. Albany, N. Y.: New York State Department of Labor.

Steel Works Analysis. By John Oliver Arnold and F. Ibbotson. Size, 7½ by 5 in.; pp., xiv, 468. Ills. Price, $3.50, 10/6. New York: The Macmillan Company; London: Whittaker & Company.

Twenty-Fourth Annual Report of the Bureau of Labor Statistics for the Year Ended September 30, 1906. Size, 9 by 6 in.; pp., clii, 894. Albany, N. Y.: New York State Department of Labor.

Nineteenth Annual Report on the Statistics of Railways in the United States for the Year Ending June 30, 1906. Size, 9 by 6 in.; pp., 766. Washington, D. C.: Interstate Commerce Commission.

Preliminary Report on the Income Account of Railways in the United States for the Year Ending June 30, 1907. Size, 9 by 6 in.; pp., 77. Washington, D. C.: Interstate Commerce Commission.

Results of Magnetic Observations Made by the Coast and Geodetic Survey Between July 1, 1906, and June 30, 1907. By R. L Faris. Size, 11½ by 8 in.; pp., 74. Washington, D. C.: Department of Commerce and Labor.

Analysis of Mixed Paints, Color Pigments and Varnishes. By Clifford Dyer Holley and E. F. Ladd. Size, 8 by 5 in.; pp., xi, 238. Ills. Price, $2.50, 10/6. New York: John Wiley & Sons; London: Chapman & Hall.

Tolhausen's Technological Dictionary. Three volumes, French-German-English, English-German-French, German-English-French. Size, 6½ by 5 in.; pp., 1006, 1026, 1025. Price, each volume, $2.75. New York: The Macmillan Company.

Twenty-First Annual Report on Factory Inspection and Twentieth Annual Report of the Board of Mediation and Arbitration for the Twelve Months Ended September 30, 1906. Size, 9 by 6 in.; pp., 762. Albany, N. Y.: New York State Department of Labor.